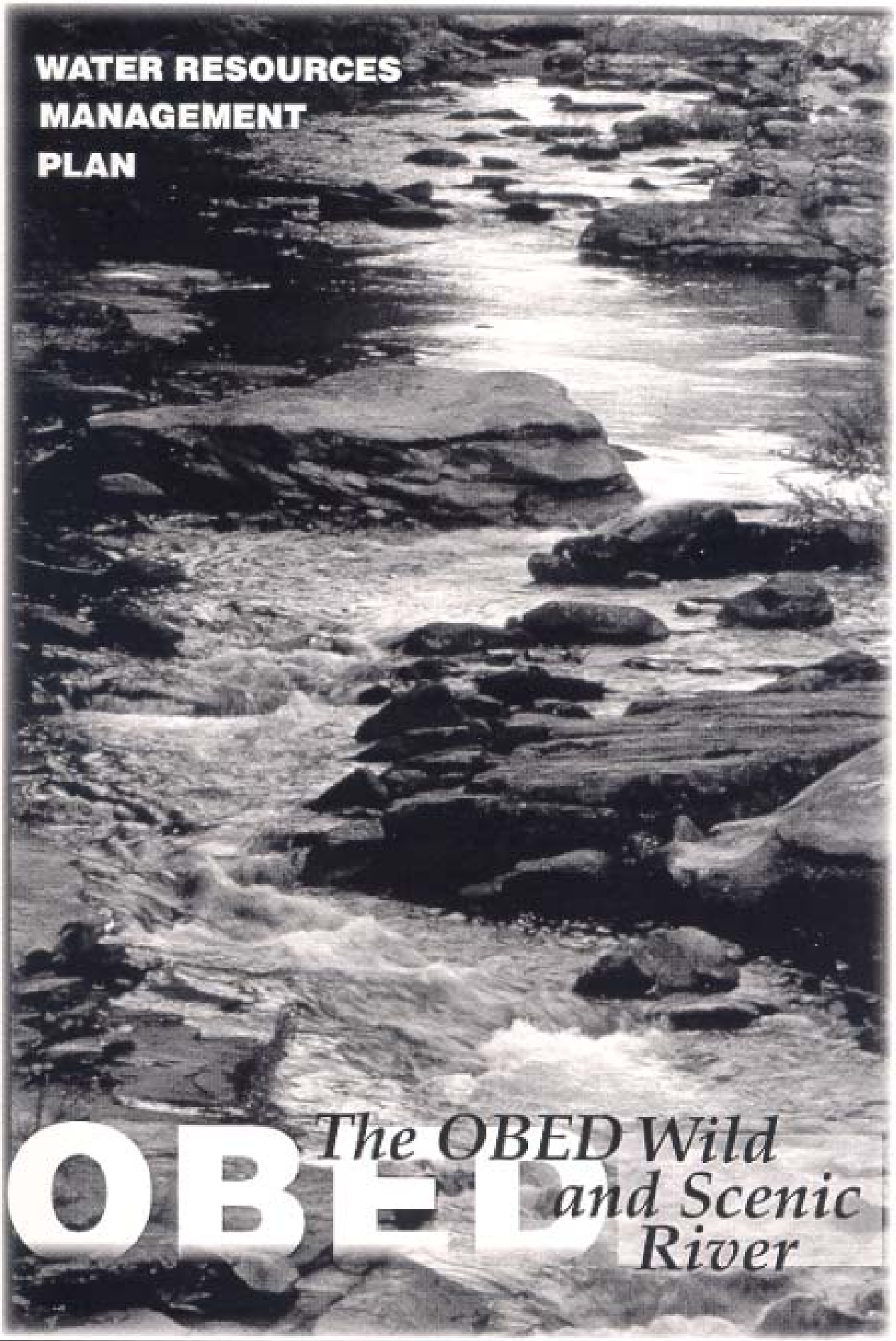
WATER RESOURCES MANAGEMENT PLAN



OBED

The OBED Wild and Scenic River

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

Obed Wild and Scenic River
Water Resources Management Plan

United States Department Of Interior
National Park Service

1998

Prepared by
Tennessee Valley Authority

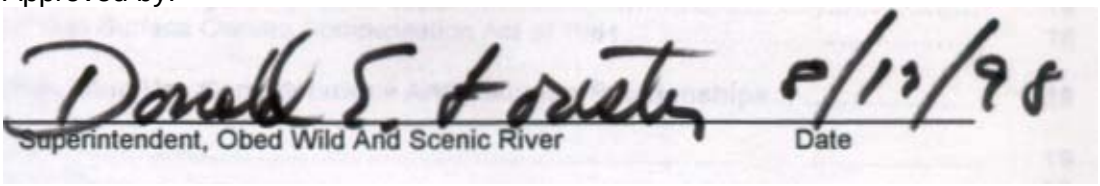
Preparation Team:

Donald Forester, Superintendent (NPS)
Monika Mayr, Former Superintendent (NPS)
Bruce Yeager, Project Manager (TVA)
Kenny Gardner (American Aquatics, Inc.)

and

Cris Hughes (TVA)
Hank Julian (TVA)
Kim Pilarski (TVA)
Steve Bakaletz (NPS)
Dan McGlothlin (NPS)
Joe Meiman (NPS)
Dave Sharrow (NPS)

Approved by:



Contents

Contents (cont.)

Contents (cont.)

Contents (cont.)

Contents (cont.)

Table Captions

Preface

The Obed Wild and Scenic River (WSR) is a 5,057 acre (2,046 hectare) unit of the National Park Service in Morgan and Cumbertand counties of Tennessee. The Obed WSR is a tributary to the Tennessee River. It offers a vast array of both cultural and natural resources. A complex network of streams drain park lands and support a diverse flora and fauna as well as provide numerous types of recreational activities.

Units of the National Park Service are not required to develop a Water Resources Management Plan (WRMP). However, Obed WSR water resource issues and management constraints are particularly numerous. This WRMP has been developed as an action plan to support the management's decision-making processes related to the protection, conservation, use and management of the Park's water resources. It is designed to identify and analyze water resource related issues where the current level of information is minimal or insufficient to meet the management goals and objectives of the National Park. Project statements were developed to address issues for future water-related management actions (including inventory, monitoring and resource management activities).

The importance of coordination and consultation with landowners, local businesses, developers, and govemment officials regarding their land use practices and future expansion plans has been identified in this Plan. Current federal, state, and local environmental legislation and regulations have been summarized.

Implementation of this program will require long-term, continuous commitments of personnel and funding. It is, however, essential in providing a level of data and hydrologic information needed by the Obed WSR for effective and wise management of its water resources, not only for its own benefit but also for the benefit of the total ecosystem of which it is a part.

Introduction

The Obed Wild and Scenic River

The Wild and Scenic Rivers Act of 1968, Public Law 90-542, declared the following as the policy of the United States:

> "that certain selected rivers of the Nation which, with their immediate environments possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of future generations."

The act also states that these rivers would be preserved "in their free flowing condition to protect the water quality and to fulfill other vital national conservation purposes."

In 1976, an amendment to the Wild and Scenic Rivers Act established the Obed Wild and Scenic River (Obed WSR), as a unit of the National Park Service (NPS), thereby giving NPS primary management responsibilities. As of 1996, the Obed Wild and Scenic River is one of 158 wild and scenic rivers nationally; it is one of only nine such river systems authorized in Southeastern U.S. It is the only national wild and scenic river in the State of Tennessee. Lands are shared by the Obed WSR National Park Service Unit and the State of Tennessee's Catoosa Wildlife Management Area (Catoosa WMA), in Cumberland and Morgan Counties. These lands remain in the ownership and care of the State by the Tennessee Wildlife Resources Agency (TWRA) through a Memorandum of Understanding (MOU) between the two agencies.

The Obed WSR is located on part of Tennessee's Cumberland plateau Cuberland and Morgan Counties (Figure 1). The Plateau lies to the east of the Highland Rim and Nashville Basin Provinces in Tennessee. Its terrain consists of flat to rolling uplands, deep river gorges, and a long line of cliffs that separate it from the lower elevations of the Ridge and Valley Province to the east. These characteristics, common to the Obed WSR, contribute to the general inaccessibility of the area and provide a unique opportunity to experience a resource relatively unchanged since it was intermittently occupied by prehistoric Native Americans.

Water resources and riparian environments are principal resources of the Obed WSR. The water is considered to be among the highest quality in the State supporting a rich ecological diversity. However, activities occurring outside the Obed WSR Park System Unit influence the waters within its boundaries. The activities include: coal mining, oil and gas exploration, quarrying, sewage discharge, agriculture and forestry practices, some residential development, garbage disposal and construction of numerous water supply ponds and impoundments on tributaries of the Obed and Emory Rivers.

Existing boundaries of the Obed WSR encompass 5,056 acres (2,046 hectares) and include portions of the Obed and Emory Rivers, and Clear and Daddys Creeks (45.2 river miles or 72.7 kilometers total). Wetlands within the Obed WSR boundaries are located in the river channel and along the stream banks. High stream gradients, rapid surface runoff and little groundwater storage create a wide range of flows in watershed streams.

General Management Plan

The National Parks and Recreation Act, P.L. 95-625 and NPS policy require that a unit of the national park system develop and implement a General Management Plan (GMP). The GMP provides the NPS with the overall basis for managing the unit's resources, uses, and facilities.

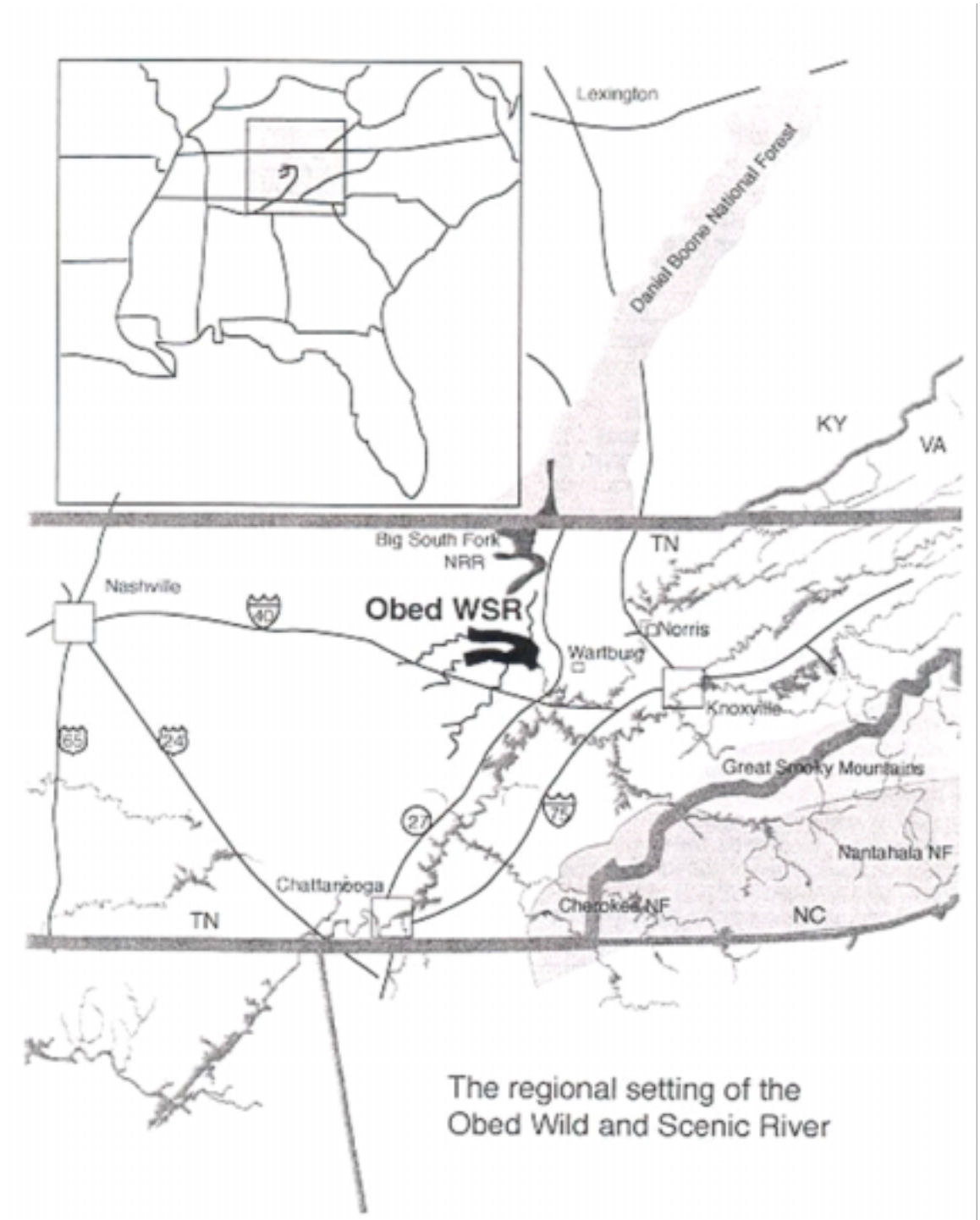


Figure 1. Location of the Obed Wild and Scenic River National Park Service Unit within the State of Tennessee and the Southeastern United States (adapted from NPS 1995).

Specific provisions for addressing the unit's resources, uses, and facilities include: land use and management, resource management, visitor use and associated facilities, operations and associated facilities, land protection, plan implementation and costs.

A GMP for the Obed WSR was completed in 1995 (NPS 1995). A portion of Catoosa WMA lands, owned and managed by the State of Tennessee, falls within the boundaries of the Obed WSR. For this reason, it was necessary for the Obed's GMP to be prepared in cooperation with the TWRA.

The GMP's primary purpose is to guide management of the Obed WSR for 10 to 15 years, including the overall resource management and use of the area in order to best serve visitors while preserving the resource values for which the Obed WSR was established. Significant resource values identified in the plan include: water quality, scenic surroundings, ecological diversity, recreational opportunities, geologic formations, fish and wildlife populations, and culturally significant sites. In order to preserve these values, the GMP recommends a strategy of working with established state and local water resource protection programs to help reduce the water quantity and quality impacts occurring from development and activities outside Obed WSR boundaries. In addition to a GMP, a Water Resources Management Plan (WRMP) is desirable in order to assist in the protection of these values inside the Obed WSR National Park Service Unit.

Purpose of the Water Resources Management Plan

After 21 years of existence, the Obed WSR requires development of a WRMP to aid future management of water-related resources within its boundaries. Where water resource issues are particularly numerous or complex, a WRMP (i.e., "action" plan) allows water-related issues to be examined in detail. It is designed to complement and conform to both a GMP and Resources Management Plan (RMP). The WRMP assists in evaluating management alternatives by reviewing and summarizing information about the Obed WSR's hydrologic resources and providing direction for water resource-related activities including inventory, monitoring and research. Both RMP and WRMP are dynamic documents that are revised, periodically, as new issues are recognized, additional information collected, or additional management alternatives identified. In general, the WRMP provides a blueprint for addressing the National Park Service Unit's water resources issues for a period of 10 to 15 years.

Several steps are typically involved in the development of a WRMP (Figure 2). The initial step is to chronicle the reasons for the National Park Service Unit's establishment and identify the significant water-related resource values of the unit. Information on these resource-specific values is then used to support the NPS's decision-making process related to the protection, conservation, use, and management of the unit's resources. Available information about the unit's water resources and water-dependent environments is also included. In addition, the WRMP contains descriptions of significant water resources management issues and the resource and legislative constraints on them. Finally, the WRMP provides a recommended management program for water resources, including recommended actions for inventory and monitoring, resources management, and research.

Water Resources Management Objectives

Water is a particularly important and sensitive ecosystem component of the Obed WSR. Its physical availability and quality are critical determinants not only of aquatic resources, but also of the overall condition of natural resources and long-term use sustainability of the Obed WSR. Water resources and stream corridors also provide important linkages within and between ecosystems, both inside and outside Obed WSR boundaries. Unfortunately, this can also work to a National Park Service Unit's disadvantage by delivering pollutants into its boundaries.

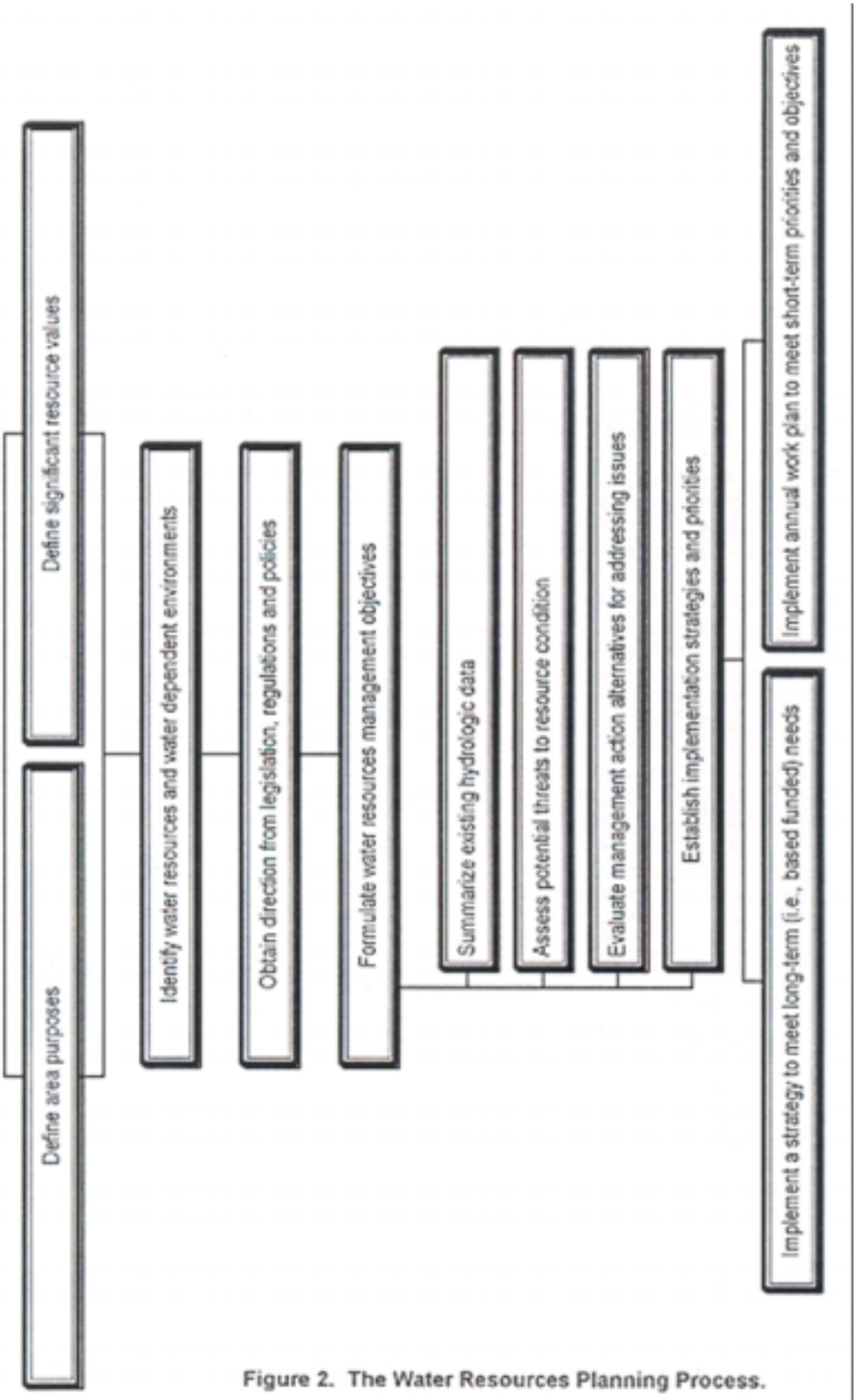


Figure 2. The Water Resources Planning Process.

A scoping workshop/public meeting was held at the onset of the WRMP development. Public awareness of the critical role that the water component plays in sustaining the Obed WSR, its tributaries, and the attributes they support was made evident. Over 41 percent of the participants identified water quality/quantity and adjacent land uses as issues of concern (TVA 1996).

Because of the important role of water in maintaining resource condition, it is the policy of the NPS to seek to maintain, rehabilitate, and perpetuate the inherent natural integrity of water resources and water-dependent environments occurring within units of the national park system (NPS 1991). Since water resources are a critical component of a larger ecosystem that spreads beyond Obed WSR boundaries, the NPS recognizes the need to cooperate with appropriate local, state, and federal regulators, land-use planning agencies, adjacent landowners, researchers, and the general public in striving to maintain the quality of the water-related resources throughout the watersheds encompassing the Obed WSR.

WRMP objectives were developed from objectives identified in the GMP (indicated in bold) to manage the extensive water-related resources of the Obed WSR and to preserve their highly significant ecosystem function:

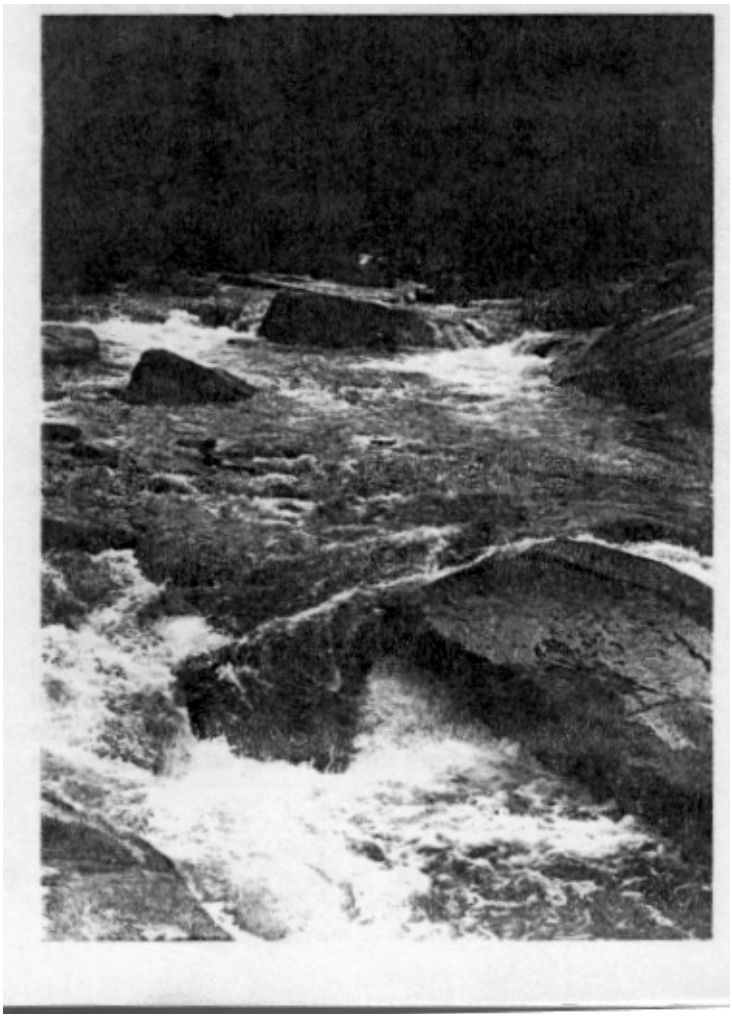
1. Maintain the highest water quality possible and a free-flowing condition for all streams within the Obed WSR.

    - Seek the highest protection designation from state water quality standards, including investigating the applicability of non-degradation standards.
    - Participate with local communities and regional, state, and federal groups in addressing issues that impact Obed WSR water resources.
    - Inventory land uses which may contribute to water quality degradation, identify and take action on real and potential pollutants.
    - Gather water and water-dependent resources information to support water quantity and quality objectives.

2. Protect the natural systems, cultural resources, landscape character, and biodiversity of the Wild and Scenic River area.
    - Define and practice stewardship on the relationships between water resources and other natural processes and human activities.
    - Understand the relationships between terrestrial, aquatic and riparian flora and fauna and human activities both within and outside Obed WSR boundaries.

3. Provide the opportunity and means to learn about, experience, and enjoy the special values of the Obed WSR (essentially primitive, unpolluted, and generally inaccessible) while assuring the protection of those values.

    - Define and protect water resources attributes significant to the visitor's experience.
    - Promote ecological and water resources stewardship through in-house and cooperative public education and outreach efforts.



Regulatory Relationships

Water Resource Legislative, Regulatory and Planning Relationships

Numerous federal and state laws, regulations and executive orders mandate specific regulatory considerations with regard to protection

and management of water-related resources in and adjacent to the Obed WSR. Additionally, policies and guidelines of the NPS broadly require management of natural resources of the national park system to maintain, rehabilitate, and perpetuate the inherent integrity of aquatic resources.

The primary federal laws governing aquatic resources management and which apply to the Obed WSR WRMP, include the NPS Organic Act, the Clean Water Act, the Endangered Species Act, the Wild and Scenic Rivers Act, the NPS General Authorities Act, the Redwood National Park Act, the Floodplain Management Executive Order (No. 11988), the Protection of Wetlands Executive Order (No. 11990), the Surface Mining Control and Reclamation Act (SMCRA), and 36 CFR 9B Non-Federal Oil and Gas Rights. Management of aquatic resources is further addressed in various applicable provisions of the Federal Power Act, the Resource Conservation and Recovery Act, the Safe Drinking Water Act, and the Food Security Act of 1985. For a more detailed list of applicable federal laws and executive orders, see Appendix A.

The Clean Water Act delegates most of its administration and enforcement requirements to the states. Therefore, states have the responsibility to regulate aquatic resources resulting in laws and regulations pertaining to aquatic resource management in NPS units. For example, Tennessee has established criteria, standards, guidelines for water quality, and erosion. The State has also established sediment control and has enacted groundwater management laws. In general, it is NPS policy to comply with these laws and regulations.
Policy regarding aquatic resources management is provided in the NPS Management Policies (NPS 1988). Specific management policies provide for protection of quality and quantity of surface water and groundwater (4:15-16), preservation of floodplains and wetlands (4:16-17), maintaining, protecting, and securing water rights (4:17), and protection of aquatic biological resources (4: 5-14). Program objectives and specific guidance regarding these goals are presented in the Program Guidance Section of NPS-77 Natural Resources Management Guidelines (NPS 1991).

Water Rights for Obed Wild and Scenic River

The precise nature and extent of the National Park Service's water rights for Obed WSR are unclear and will remain uncertain until determination is made by the courts. In general, it is clear the United States has riparian water rights within the National Park Service Unit by virtue of its status as a riparian landowner, although these rights are currently undefined. The present value of these rights is to maintain stream flows for natural conditions, the National Park Service Unit does not withdraw water from streams for consumptive uses in support of the Unit administration.

It is unclear to what extent Federal rights established by the Wild and Scenic Rivers Act (October 2, 1968, 82 Stat. 906) for Obed WSR may protect Unit resources from future alterations in flow. Section 13 (c) of the Wild and Scenic Rivers Act states that rights are established for wild, scenic, or recreational rivers for the primary purposes of the act. These primary purposes include rivers which "possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values," and that they" ..shall be preserved in free-flowing condition, and that they and their immediate environs shall be protected for the benefit and

enjoyment of present and future generations." To date there has been no court case documented where the water rights for a Wild and Scenic River have been defined in a riparian doctrine State.

Federal Laws, Regulations and Executive Orders Pertinent to Management of NPS Water Resources and Watersheds Affecting the Obed WSR

National Park Service Organic Act of 1916

Through this act, Congress established the NPS and mandated that it "shall promote and regulate the use of the federal areas known as national parks, monuments, and reservations by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." This act was reinforced by the General Authorities Act of 1970 with legislation stating that all park lands are united by a common preservation purpose, regardless of title or designation. Hence, all water resources in the national park system are protected equally by federal law, and it is the fundamental duty of the NPS to protect those resources unless otherwise indicated by Congress.

Wild and Scenic Rivers Act of 1968

In accordance with this act, it is:

> the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. The purpose of this act is to implement this policy by instituting a national wild and scenic rivers system, by designating the initial components of that system, and by prescribing the methods by which and standards according to which additional components may be added to the system from time to time."

Section 2 of this act states:

> "The national wild and scenic rivers system shall comprise rivers (i) that are authorized for inclusion therein by act of Congress, or (ii) that are designated as wild, scenic or recreational rivers by or pursuant to an act of the legislature of the state or states through which they flow, that are to be permanently administered as wild, scenic or recreational rivers by an agency or political subdivision of the state or states concerned, that are found by the Secretary of the Interior upon application of the Governor of the state or the Governors of the states concerned, or a person or persons thereunto duly appointed by him or them, to meet the criteria established in this act and such criteria supplementary thereto as he may prescribe, and that are approved by him for inclusion in the system, including, upon application of the Governor of the state concerned."

In February 1968, the Obed River and its tributaries were included in a bill which became the Tennessee Scenic Rivers Act. However, strong organized support persisted locally for the construction of a high dam on the Obed River (NPS 1993). Since the 1968 restudy of the feasibility for the dam project was then underway, the Obed River and its tributaries were deleted from the bill prior to its enactment. However, other citizens groups including the Tennessee Scenic Rivers Association and the Tennessee Citizens for Wilderness Planning favored preserving the river. Largely through the efforts of these two organizations, the Obed River, Clear Creek, and Daddys Creek were included in Section 5 (a) of the Wild and Scenic Rivers Act in October 1968 which placed them in a study category for future inclusion (NPS 1993).

In 1976, Public Law 94-486 amended the original act to establish the Obed Wild and Scenic River (Obed WSR) encompassing 45.2

river miles on portions of the Obed and Emory Rivers, and Clear and Daddys Creeks in Morgan and Cumberland Counties, Tennessee. The NPS has primary management responsibilities for the Obed WSR. Lands currently within Obed WSR boundaries that are part of the Catoosa Wildlife Management Area (Catoosa WMA) will continue to be owned and managed by the TWRA in such a way as:

> "to protect the wildlife resources and the primitive character of the area and without further development of roads, campsites or associated recreational facilities unless deemed necessary by that agency for wildlife management purposes."

The legislation required that a development plan be prepared and include a cooperative agreement between the two agencies due to their joint management responsibilities.

Although the Obed is only one unit in the national wild and scenic rivers system (a system containing some 158 rivers nationally), it is one of only nine such units that has been authorized in the Southeastern U.S. It is the only National Wild and Scenic River in the State of Tennessee and the only Wild and Scenic River managed by the Southeast Region of the NPS.

Redwood National Park Act

In 1978, an act expanding Redwood National Park (i.e., Redwood National Park Act), NPS general authorities were further amended to specifically mandate that all park system units be managed and protected "in light of the high public value and integrity of the national park system" and that no activities should be undertaken "in derogation of the values and purposes for which these various areas have been established," except where specifically authorized by law. Thus, by amending the General Authorities Act of 1970, the act reasserted system-wide the high standard of protection prescribed by Congress in the original Organic Act.

The Redwood Act qualifies the provision that park protection and management "shall not be exercised in derogation of the values and purposes for which these various areas have been established, "by adding" except as may have been or shall be directly and specifically provided for by Congress." Thus, specific provisions in a park's enabling legislation allow park managers to permit activities such as hunting and grazing.

Federal Water Pollution Control Act (Clean Water Act) of 1972

The Federal Water Pollution Control Act, more commonly known as the Clean Water Act, was first promulgated in 1972 and amended in 1977, 1987, and 1990. This law is designed to restore and maintain the integrity of the nation's water, including the waters of the national park system. Goals set by the act were swimmable and fishable waters by 1983 and no further discharge of pollutants into the nation's waterways by 1985. The two strategies for achieving these goals were a major grant program to assist in the construction of municipal sewage treatment facilities, and program of "effluent limitations" designed to limit the amount of pollutants that could be discharged. Effluent limitations are the basis for permits issued for all point source discharges, known as the National Pollutant Discharge Elimination System (NPDES). The Environmental Protection Agency (EPA) has set limits for pollutants that may be released based on available technology and cost of treatment for various industrial categories.

As part of the act, Congress recognized the primary role of the states in managing and regulating the nation's water quality within the general framework developed by Congress. Part of that framework, namely Section 313, requires that all federal agencies, including the NPS, comply with the requirements of state law for water quality management, regardless of other jurisdictional status or land-ownership. States implement the protection of water quality under the authority granted by the Clean Water Act through BMPs and through water quality standards. Standards are based on the designated uses made of a water body or segment, the water quality criteria necessary to protect that use or uses, and an anti-degradation provision to protect the existing water quality. Criteria are descriptions of maximum or minimum physical, chemical, and/or biological characteristics of water that

reflect tolerances and requirements for human health, aquatic biota, and aesthetics which will protect the designated uses. Designated uses for the waters of Tennessee (including the Obed WSR) include: sources of water supply for domestic and industrial purposes, propagation and maintenance of fish and other aquatic life; recreation in and on the water including the safe consumption of fish and shell fish; livestock watering and irrigation; navigation; generation of power; propagation and maintenance of wildlife; and the enjoyment of scenic and aesthetic qualities of waters. The standards also serve as the basis for water quality-based treatment and establish the water quality goals for the specific stream segment or water body. A triennial review of a state's water quality regulatory program is conducted by a state's water quality agency to determine if the standards are adequate. These standards are then forwarded to the EPA for approval.

The EPA promotes the concept that a state's anti-degradation policy (adopted as part of the States' Water Quality Standards) which represents a three-tiered approach to maintaining and protecting various levels of water quality and uses. At its base, the existing uses of a water segment and the quality level necessary to protect the designated uses are maintained (i.e., water quality can be degraded as long as the designated uses are protected). This establishes the absolute foundation for water quality. The second level provides protection of existing water quality in segments where quality exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water (i.e., those segments meeting the "fishable/swimmable" goals of the Clean Water Act). In such segments, only limited water quality degradation can be allowed after it has been shown through a demonstration process, which includes public participation, that the quality will continue to support the "fishable/swimmable" uses. The third tier provides special protection for waters for which ordinary use classification may not suffice and which are classified as "Outstanding National Resource Water" (ONRW) a designation used by the State of Tennessee. The purpose of this special designation is to safeguard a state's highest quality waters and also to maintain the quality of waters that have ecological importance.

Section 401 of the Clean Water Act requires that any applicant for a federal license or permit to conduct an activity which will result in a discharge into waters of the U.S., shall provide the federal agency from which a permit is sought a certificate from the state water pollution control agency that any such discharge will comply with applicable water quality standards. Federal permits which require Water Quality Certification from the Tennessee Division of Water Pollution Control include 404 permits from the U.S. Army Corps of Engineers (USACE) for the discharge of dredged or filled material, 26(a) permits from the Tennessee Valley Authority (TVA) to insure that no adverse effects to TVA reservoirs will result from a proposed action, and permits for hydroelectric projects from the Federal Energy Regulatory Commission (see full discussion in planning section).

Section 402 of the act requires that a National Pollutant Discharge Elimination System (NPDES) permit be obtained for the discharge of pollutants from any point source into the waters of the U.S.. Point source, waters of the U.S., and pollutants are all broadly defined under the act. However, generally all discharges and storm water runoff from municipalities, major industrial and transportation activities, and certain construction activities must be permitted by the NPDES program. The State of Tennessee has been delegated NPDES permitting authority by the EPA. The State, through the permitting process, establishes the effluent limitations and monitoring requirements for the types and quantities of pollutants that may be discharged into its waters. Under the anti-degradation policy, the State must also insure that the approval of any NPDES permit will not eliminate or otherwise impair or degrade any designated uses of the receiving waters.

Section 404 of the Clean Water Act further requires that a permit be issued for discharge of dredged or fill materials in waters of the United States including wetlands. The USACE administers the Section 404 permit program with oversight and veto powers held by the EPA.

Endangered Species Act of 1973

The Endangered Species Act requires the NPS to identify and promote the conservation of all federally listed endangered, threatened or candidate species within park or preserve boundaries. While not required by legislation, according to NPS Management Policies (NPS 1988), it is NPS's policy to also identify state and locally listed species of concern and support the preservation and restoration of those species and their habitats. As of 1996, the USFWS lists five threatened and endangered species and one critical habitat within the boundaries of the Obed WSR (Appendix B).

This act requires all entities using federal funding to consult with the Secretary of the Interior on activities that potentially impact endangered flora and fauna. It requires agencies to protect endangered and threatened species as well as designated critical habitats.

Floodplain Management Executive Order (No. 11988)

The objective of Executive Order (EO) 11988 (Floodplain Management) is to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative" (WRC 43 FR 6030). For non-repetitive actions, EO 11988 states that all proposed facilities must be located outside the limits of the 100-year floodplain unless alternatives are evaluated which would either identify a better option or support and document a determination of "no practicable alternative" to siting within the floodplain. If this determination can be made, adverse floodplain impacts would be minimized during design of the project. West (1990) suggested that park service managers should ensure that where park resources fall within flood hazard areas, these areas are properly marked to increase public awareness of potential flood dangers at the site. To the extent possible, park facilities such as campgrounds and rest areas should be located outside these areas. NPS guidance pertaining to Executive Order 11988 can be found in Floodplain Management Guidelines (NPS 1993a). Ins NPS policy to recognize and manage for the preservation of floodplain values, to minimize potentially hazardous conditions associated with flooding, and to adhere to all Federally Mandated laws and regulations related to the management of activities in flood-prone areas. Particularly, it is the policy of the NPS to:

- restore and preserve natural floodplain values
- avoid to the extent possible, the long and short-term environmental impacts associated with the occupancy and modification of floodplain, and avoid direct and indirect support of floodplain development wherever there is a practicable alternative
- minimize risk to life and property by design or modification of actions in floodplain, utilizing non-structural methods when possible, where it is not otherwise practical to place structures and human activities outside of the floodplain
- require structures and facilities which must be in floodplain to be designed so as to be consistent with the intent of the Standards and Criteria of the National Flood Insurance Program (44 CFR 60)

Protection of Wetlands Executive Order (No. 11990)

Executive Order 11990, entitled "Protection of Wetlands", requires all federal agencies to "minimize the destruction, loss or degradation of wetlands, and preserve and enhance the natural and beneficial values of wetlands" (Goldfarb 1988). Unless no practical alternatives exist, federal agencies must avoid activities in wetlands which have the potential for adversely affecting the integrity of the ecosystem. NPS guidance for compliance with Executive Order 11990 can be found in "Floodplain Management and Wetland Protection Guidelines", published in the Federal Register (45 FR 35916, Section 9).

National Environmental Policy Act of 1969

Congress passed the National Environmental Policy Act (NEPA) in 1969. Environmental

compliance in the NPS encompasses the mandates of NEPA and all other federal environmental laws that require evaluation, documentation and disclosure, and public involvement, including the Endangered Species Act, Clean Water Act, Executive Orders on Floodplains and Wetlands, and others (NPS 1991).

All natural resource management and scientific activities are subject to environmental analysis under NEPA. Parks are encouraged to participate as cooperating agencies (40 CFR 1501.6) in the environmental compliance process to the fullest extent possible when the NPS resources may be affected, and as set forth in Council on Environmental Quality (CEQ) regulations (NPS 1991). Participation by the NPS in the environmental compliance processes of other agencies and jurisdictions is an important managerial tool. It can provide the NPS with information that will allow the Service to respond to possible external threats to a park well before they occur.

Section 102 of NEPA sets forth a procedural means for compliance. The CEQ regulations further define the requirements for compliance with NEPA. Detailed NEPA guidance is contained in NPS-12.

Surface Mining Control and Reclamation Act (SMCRA) of 1977

The purpose of **this** act is to establish a nationwide program to protect the environment from adverse effects of surface coal mining operations, to establish minimum national standards for regulating surface coal mining, to assist states in developing and implementing regulatory programs, and to promote reclamation of previously mined areas left without adequate reclamation. The act contains several provisions that are important to park protection at Obed WSR. While no active coal mines exist in Obed WSR, two active coal mines operate near the park. Also, to date, two abandoned coal mines have been identified in the park and have undergone some degree of safety hazard mitigation. Finally, an abandoned mine exists in proximity to the park's boundary.
Under §522(e), the Act prohibits surface coal mining in units of the National Park System subject to "valid existing rights." This same section also prohibits surface coal mining that will adversely affect any publicly owned park or place on the National Register of Historic Places unless the mining proponent has" valid existing rights" to mine or if the agency with jurisdiction over the park or place gives its approval. Because of Obed WSR's location within a known coal area, both of these provisions provide an added level of protection to the park's resources and visitor values. In Tennessee, because the state does not have a state approved regulatory program, the implementation of the above provisions and the actual permitting of surface coal mines in the state rests with the USOSM.

Via §401 of the Act, Congress established the Abandoned Mine Reclamation Fund which receives funds from currently mined coal on a per ton basis. The Fund serves as a source of moneys for reclaiming land and water adversely affected by coal mining. To be eligible for funding, the lands and water had to have been mined or adversely affected by coal mining prior to enactment of the Act. Funds may be expended on both public and private land.

36 CFR 9B Non-federal Oil and Gas Rights

Pursuant to the Mining in Parks Act of 1978, the NPS developed regulations found at 36 CFR Part 96 to provide protection to park resources that could be affected by the exercises of rights to non-federal oil and gas which is only accessible by way of federally owned or controlled lands or waters. According to the Non-Federal Oil and Gas Regulations 71-87 edition, Section 9.30, such regulations "control all activities within any unit of the national park system in the exercise of rights to oil and gas not owned by the U.S., where access is on, across, or through federally owned or controlled lands or waters" (Section 9.30). The regulation sections specific to water include regulated use of water, required description of natural resources (including water impacted by operations), and measures to protect surface and subsurface water. All operation plans must be reviewed and approved by the

Director of the Southeast Region (in the case of the Obed WSR).

Off-road Vehicle Use Executive Orders (No.'s 11644 and 11989)

When the enabling legislation allows the use of off-road vehicles, the NPS is required to manage off-road vehicle use under a policy that park system unit lands will be closed to such use except for areas or trails specifically designated as open. If it is determined that such use is adverse to resources, the NPS is to immediately close such areas or trails until the effects have been corrected.

Fish and Wildlife Coordination Act of 1965

This act requires federal agencies to consult with the USFWS, or National Marine Fisheries Service, and with parallel state agencies, whenever water resource development plans result in alteration of a body of water. The Secretary of the Interior is authorized to assist and cooperate with federal agencies to "provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs."

Energy Policy Act (EPA) of 1992

One major provision of EPA (1992) was a broadening of the existing ban on development of hydroelectric projects within national parks. New language bans new hydroelectric development within any unit of the national park system, including recreational areas, historical sites, and other units of the NPS. Previously, the ban affected only national parks and not other NPS units.

Safe Drinking Water Act of 1986

This act directs EPA to publish and enforce regulations on maximum allowable contaminant levels in drinking water. The act requires EPA to issue regulations establishing national primary drinking water standards; primary enforcement responsibilities lie with the states. The act also protects underground sources of drinking water; primary enforcement responsibilities again lie with the states. Federal agencies having jurisdiction over public water systems must comply with all requirements to the same extent as any non-governmental entity.

Sales of Park Water Under Public Law 91 -383 (August 18, 1970)

Request for the NPS to provide water from park springs to a community adjacent to Grand Canyon National Park resulted in the Passing of Public Law 91 -383 in 1970 and its amendment in 1976 (P.L. 94-458). This law provides for the NPS to enter into contracts to sell or lease water to nearby communities, while recognizing that water is necessary for the protection of scenic, natural, cultural and scientific resources. The law establishes several tests that must be met before park waters can be sold or leased. Among the tests are: (1) that no reasonable alternative source of water exists, (2) that the services supported by the water sale are for the direct or indirect benefit of the park or park visitors, (3) that it is demonstrated that the sale is not detrimental to the park, its resources and visitors, (4) that the sale is consistent with federal water rights, and (5) that any agreement is short term and revocable at any time. Any agreement to sell or lease water must also be reviewed by the appropriate congressional committees.

State of Tennessee Laws, Programs, and Regulations Pertinent to Management of NPS Water Resources and Watersheds Affecting the ObedWSR

Water Rights in Tennessee

The riparian water rights doctrine governs the use of surface water in Tennessee. Riparian rights are related to, and arise from, ownership of land abutting a body of water. The NPS is considered a riparian landowner since it owns land abutting the streams comprising Obed WSR. The rights of those who own the land include consumptive and non-consumptive uses (Dellapenna 1991).

Although it is not specifically stated, the State of Tennessee is considered to adhere to the theory of reasonable use for purposes of allocating both surface and groundwater. Reasonable use is defined as “each owner of riparian land is permitted to use the water in a waterbody, regardless of the effect the use has on the natural flow, so long as each user does not transgress the equal right of other riparians to use the water” (Dellapenna 1991). Reasonableness under the riparian doctrine is not subject to simple definition and is decided by the courts after examining many factors such as purpose of use, suitability to watercourse, economic or social value, harm caused by the use, practicality of avoiding harm by adjusting use of one or both of the parties, and the protection of existing values. Typically, riparian rights are asserted for water diverted out of the stream. Riparian rights could be asserted downstream from existing diversions to maintain flow levels (assuming flow levels could be reasonably maintained, given hydrologic conditions of the stream) for beneficial and reasonable uses of water.

Under the Riparian Doctrine, no formal priority exists for water uses. However, Tennessee appears to recognize two preferred uses of water: withdrawal of water for domestic use, and instream use for navigation (Thompson 1991). It is unclear if domestic use includes municipal uses. It appears the courts have recognized at least five instream uses of water: navigation, recreation, hydroelectric power generation, fish and wildlife preservation, and aesthetic enhancement (Thompson 1991). Though not a water right requirement per se, a permit must be obtained from the Tennessee Division of Water Resources for all water uses (except public water systems) greater than 50,000 gallons per day.

A list of Tennessee laws, programs, and regulations considered by the NPS to be the most pertinent to the Obed WSR’s water resources follows. For a more thorough list, see Appendix C.

Water Quality Control Act of 1971

The Water Quality Control Act of the State of Tennessee aims to protect water quality

(1971)

The Policy and Purpose of the Tennessee Water Quality Control Act

- Recognizing that the waters of Tennessee are property of the State and are held in public trust for the use of the people of the State, it is declared to be the public policy of Tennessee that the people of Tennessee, as beneficiaries of this trust, have a right to unpolluted waters. In the exercise of its public trust over the waters of the State, the government of Tennessee has an obligation to take all prudent steps to secure, protect, and preserve this right.

- It is further declared that the purpose of this part is to abate existing pollution of the waters of Tennessee, to reclaim polluted waters, to prevent the future pollution of the waters, and to plan for the future use of the waters so that the water resources of Tennessee might be used and enjoyed to the fullest extent consistent with the maintenance of unpolluted waters.

- Moreover, an additional purpose of this part is to enable the State to qualify for full participation in the national pollutant discharge elimination system established under Section 402 of the Federal Water Pollution Control Act, Public Law 92-500.

- Additionally, it is intended that all procedures in this part shall be in conformity with the Uniform Administrative Procedures Act, compiled in title 4, chapter 5.

cts 1971, ch. 164, Sec. 2; 1977, ch. 366, Sec. 1; T.C.A. Sec. 70-325; Acts 1992, ch. 684, Sec. 1.]

through the regulation of pollution sources, the monitoring of streams and lakes, and through public education. The State Water Quality Control Board is identified in the act, as having the duty to investigate all problems associated with the pollution of Waters of the State. The Board has the authority to grant permission or abate any activities that may result in pollution of the Waters of the State. It has the authority to establish such standards of quality for any Waters of the State in relation to their reasonable and necessary use as the Board deems to be in the public interest. The Board can also establish general policies relating to pollution as it deems necessary to accomplish the purposes of the act.

State Protected Water Uses. The State of Tennessee Water Quality Standards, part of the Water Quality Control Act, describe the reasonable and necessary uses of water within the State that are deemed to be in the public interest. Such uses include: sources of water supply for domestic and industrial purposes, propagation and maintenance of fish and other aquatic life; recreation in and on the waters including the safe consumption of fish and shell fish; livestock watering and irrigation; navigation; generation of power; propagation and maintenance of wildlife; and the enjoyment of scenic and aesthetic qualities of waters. State Protected Water Uses designated for the Obed/Emory River watershed are found in Table I (TDEC 1995).

Some of the criteria described within State Protected Water Uses include, but are not limited to, dissolved oxygen (DO), pH, hardness or mineral compounds, total dissolved solids, solids, floating materials and deposits, turbidity or color, temperature, coliform, taste or odor, toxic substances, and one criteria that deals with other pollutants.

State Water Quality Standards insure that the Waters of the State shall not contain other pollutants in quantities that may be detrimental to public health or impair the usefulness of the water as a source of domestic water supply.

State Water Quality Standards also define what is considered to be unacceptable discharges into Waters of the State. To quote this section of the Standards,

> "Sewage, industrial wastes, or other wastes, as defined in the Water Quality Control Act. Sec. 69-3-101, *et. seq.,* shall not be discharged into or adjacent to streams or other surface waters in such quantity and of such character or under such conditions of discharge in relation to the receiving waters as will result in visual or olfactory nuisances, undue interference to other reasonable and necessary uses of the water or appreciable damage to the natural processes of self-purification. In relation to the various qualities and the specific uses of the receiving water, no sewage, industrial wastes, or other wastes discharged shall be responsible for conditions that fail to meet the water quality standards. Bypassing is prohibited except where necessary to prevent loss of life or severe property damage, or where excessive storm drainage or runoff would damage treatment facilities."

As outlined in the Water Quality Control Act:

> "All discharges of municipal sewage, industrial waste, or other wastes shall receive the greatest degree of effluent reduction which the Commissioner of the Tennessee Department of Environment and Conservation determines to be achievable through application of stringent

Table 1. State Protected Water Uses for the Obed/Emory Watershed.

Stream	Description	Domestic Water Supply	Industrial Water Supply	Fish & Aquatic Life	Recreation	Irrigation	Livestock Watering & Wildlife
Emory River	Mile 0 to Origin	X	X	X	X	X	X
Obed River	Mile 0 to Origin			X	X	X	X
Daddys Creek	Mile 0 to Origin			X	X	X	X
Basses Creek	Mile 0 to Origin			X	X	X	X

effluent limitations and schedules of compliance either promulgated by the Water Quality Control Board, required to implement any applicable water quality standards, including where practicable, a standard permitting no discharge of pollutants, necessary to comply with a State Water Quality Plan, or necessary to comply with other state or federal laws or regulations."

State Anti-degradation Policy. An anti-degradation policy, which applies to the Obed WSR, is found within the State Water Quality Standards. The Tennessee Anti-degradation Statement is as follows:

> "It is the purpose of Tennessee's standards to fully protect existing uses of all surface waters as established under the act … The Tennessee Water Quality Standards shall not be construed as permitting the permanent degradation of high quality surface waters. Characteristics of high quality waters include: (a) Waters designated by the Water Quality Control Board as Outstanding National Resource Waters (ONRW5) in accordance with Section 1200-4-3-.06(3); (b) Waters that provide habitat for ecologically significant populations of aquatic or semi-aquatic plants or animals, including those identified on State of Tennessee or U.S. Fish & Wildlife Service (USFWS) lists of rare, threatened, or endangered species; (C) Waters that provide specialized recreational opportunities related to existing water quality; (d) Waters that possess outstanding scenic or geologic values; (e) Water where existing conditions are better than water quality standards.
>
> Waters of the State receiving the ONRWs designation by the Water Quality Control Board are considered to be high quality waters which constitute an outstanding national resource, such as waters of national and state parks and wildlife refuges and waters of exceptional recreational or ecological significance. Existing water quality will be the criteria in these waters. Existing discharges, including existing upstream discharges will be allowed at present levels. No new discharges, expansions of existing discharges, or mixing zones will be permitted in waters with this designation unless such activity can consistently meet or exceed the water quality conditions of the ONRW or unless such activity will not result in permanent degradation of the water quality. Physical alterations that cause permanent degradation to the ONRW will not be allowed.

After full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, no permanent degradation is allowed by the State of Tennessee unless and until it is affirmatively demonstrated to the Water Quality Control Board that a change is justifiable as a result of necessary economic or social development. Also, it must not interfere with or become injurious to any classified uses, existing in such waters, and deemed to be in the public interest (see State Protected Water Uses section for a listing of uses). Existing discharges, including existing upstream discharges, will be allowed at present levels. Regulated non-point sources will be controlled to the extent possible under the Water Quality Control Act and standards. Non-point sources exempted from permit requirements under the Water Quality Control Act should utilize all cost-effective and reasonable BMPs.

TDEC's Division of Water Pollution Control issues several types of permits. Activities requiring permits include the discharge of a pollutant to public waters, the alteration of aquatic resource, and gravel dredging from a watercourse. The Division also issues permits for mineral mining and reviews or certifies permits issued and administered by federal agencies. Additionally, construction or modification of wastewater treatment facilities must be carried out in accordance with plans approved by the Division.

NPDES Permitting System. There are three sections within the Division with National Pollutant Discharge Elimination System (NPDES) responsibilities. The Mining Section issues NPDES Permits for all mining activities in Tennessee. Surface Mining as well as NPDES Permits are issued under T.C.A. 59-8-204 for the "other minerals" or non-coal operations subject to regulation under this act.

The USOSM issues mining permits for coal. The Municipal Facilities Sections issue municipal, small domestic, and industrial permits.

Waste-load allocations are computer simulations of discharges into a receiving stream. The model calculates the levels of pollutants in the stream and estimates decay rates. Permit limits are adjusted according to the results of the model. A Total Maximum Daily Load (TMDL) also uses computer models to estimate pollutant loading into a stream. However, a TMDL estimates loading from both point and non-point sources of pollution. Because they are very labor and time intensive, TMDLs are typically only performed on streams that have water quality problems that waste-load allocations and new permit limits have not solved.

Pretreatment Program. The federal pretreatment regulations require all state agencies administering the NPDES permit program to develop and administer a state pretreatment program. The pretreatment program is designed to reduce the loading of pollutants into municipal facilities as a way to improve compliance rates. The program is also responsible for sludge disposal, protecting the receiving stream, and enforcing pretreatment standards.

The Division is requiring a significant number of wastewater plants to develop a pretreatment program as the primary vehicle for administering, applying, and enforcing National Pretreatment Standards (40 CFR Part 403.S and 403.6) for industrial users. This strategy requires wastewater plants to have complete local programs whereby notification of industrial users concerning pretreatment standards will be the responsibility of the municipality. The Division will then have an oversight role in which a minimal amount of resources will be committed to applying and enforcing National Pretreatment Standards against indirect discharges.

Section 404 Certification. Section 404 of the federal Clean Water Act regulates the disposal (discharge) of dredged or fill material into the waters of the Untied States, including wetlands. This program is administered by the USACE and the U.S. Environmental Protection Agency (USEPA). The USACE has primary responsibility for the permit program.

Section 401 of the Clean Water Act requires that before a 404 Permit may be issued, the state must first certify that the proposed activity will not violate local water quality regulations and standards. The Division's Natural Resources Section reviews USACE 404 Permit applications for compliance with the state's regulations and issues certificates as prescribed by Section 401 of the Clean Water Act. Without state certification or waiver of certification, the 404 Permit cannot be granted. The Nashville District of the USACE reviews permits in the Obed River watershed.

The TDEC's Division of Water Pollution Control issues Aquatic Resource Alteration Permits and General Permits for Alteration of Aquatic Resources, both permits pertaining to water quality, under the authority of the Tennessee Water Quality Control Act of 1977 (T.C.A. 69-3-101). This act authorizes water quality permits primarily for work resulting in modification of the physical or biological properties of the waters of the State (TDEC 1994).

Aquatic Resource Alteration Permit (ARAP). Aquatic Resource Alteration permits are required for any alteration of waters of the State including wetlands whether or not a Federal 404 permit, under the Clean Water Act, is required. Examples of stream alteration activities requiring permits include:

- dredging, widening, straightening, bank stabilization
- levee construction
- channel relocation
- water diversions or dams
- water withdrawals
- flooding, excavating, or draining a wetland

General Permits for Alteration of Aquatic Resources. General permits are available for certain activities that involve alterations of waters of the State. General permits provide authorization for activities that cause minimal individual or cumulative impacts to water quality. The regulations establish specific, enforceable standards of pollution control for

work authorized by them. General permits are available for the following activities:

- sand and gravel dredging, within the stream corridor
- construction of launching ramps
- alteration of wet weather conveyances
- minor road stream crossings
- utility line stream crossings
- bank stabilization (of streams)
- debris removal

The Safe Dams Act of 1973

The Safe Dams Act provides that on or after July 1, 1973, no person shall construct, enlarge, repair, alter, remove, maintain, or operate a non-federal dam in the State of Tennessee without first obtaining a certificate. The act further requires every owner of a dam file with the Commissioner of Health and Environment to obtain an application for a certificate.

Under the act, certain provisions and conditions are established for the issuance and continuance of certificates, and authority is granted to the commissioner for the adoption of general rules and regulations that he deems necessary to accomplish the purpose of the act. To safeguard the public by reducing the risk of failure of such dams, certain rules and regulations are made to: (1) effect the orderly inventory and inspection of existing dams in Tennessee, (2) provide for pre-construction review and approval of all future dam construction and alteration of dams, and (3) allow for a program of regular inspection of dams within the State.

Mineral Test Hole Regulatory Act of 1982

This act regulates the drilling of mineral test holes in order to prevent the pollution of potable water resources, both surface and subsurface, as the result of the introduction of undesirable substances, including natural brines, oil, gas, or mineralized waters through the process of the drilling of mineral test holes. It also provides basic geologic data to the State related to oil, gas, and water occurrences.

Oil and Gas Surface Owners Compensation Act of 1984

The general assembly of the State of Tennessee finds that the exploration for and development of oil and gas reserves must coexist with the equal right to the use, agricultural or otherwise, of the surface of land within the State. Therefore, it is the purpose of this act is to provide constitutionally permissible protection and compensation to surface owners of land on which oil and gas wells are drilled for the burden resulting from such drilling operations.

Land Status, Land Use Considerations and Planning Relationships

Introduction

This chapter describes land-ownership, land uses, and planning issues that affect water resource planning in the WSR. The diversity of land uses in the study area dictates that water resource planning take into account land uses within the WSR boundaries as well as land uses external to the WSR within the Obed/Emory River watershed.

Land-ownership

Land-ownership patterns in the WSR are of four types: (1) federal lands owned in fee, (2) state owned lands, including Catoosa Wildlife Management Area, the streambeds within the WSR, and bridge crossings, (3) privately-owned lands yet to be acquired, and (4) private lands having federal easements subject to land use restrictions. These are summarized in Table 2.

Federal Lands. The total area of the Obed WSR is approximately 5,056 acres (2046.2 hectares), 2,050 acres (829.63 hectares) of which is owned by the NPS in fee. The actual lands Congress legislated for the Obed WSR consist of:

- approximately 24 miles (38.6 kilometers) of Obed River and adjacent lands from the Western edge of the Catoosa WMA boundary to its confluence with the Emory River
- approximately 17 miles (27.3 kilometers) of Clear Creek and adjacent lands from the Morgan County Line to its confluence with the Obed River
- approximately 2.5 miles (10.05 kilometers) of Daddys Creek and adjacent lands from the Morgan County Line to its confluence with the Obed River, and approximately 1 mile (1.6 kilometers) of the Emory River and adjacent lands from its confluence with the Obed River to the Nemo Bridge

TVA owns seven river/creek access sites within the Obed River system, each being approximately 1.5 acres (0.6 hectares) in size (Table 3). However, no TVA access sites occur within the Obed WSR boundaries.

State Lands. Wild and Scenic River lands within the Catoosa WMA, as determined by Congress when the WSR was designated, will continue to be owned and managed by TWRA, in a manner compatible with the purposes outlined in the Wild and Scenic Rivers Act. The State of Tennessee retains fee ownership of 57.4 acres (23.2 hectares) above the ordinary high water line. These lands are managed as part of the WSR by Memorandum of Understanding between the TWRA and the NPS. It is understood (by the NPS) that the State of Tennessee is also the fee owner of

Table 2. Summary of NPS Managed Lands in Obed Wild and Scenic River, 1995 data.

Owned in Fee by NPS	2,050.0 acres	829.6 hectares
Easements Purchased by NPS	1,066.0 acres	431.4 hectares
Owned by the State of Tennessee		
above high water line	57.4 acres	23.2 hectares
riverbed	269.0 acres	108.9 hectares
Remaining to be purchased	1,613.6 acres	653.0 hectares
TOTAL ACRES	5,056 acres	2,046.2 hectares

Table 3. TVA Owned River/Creek Access Sites Within The Obed River System.

Creek	Access Site	County	River/Creek Mile
Crab Orchard Creek	White Rock Ford	Morgan	10.6
Daddys Creek	Centers Bridge	Cumberland	17.5
Daddys Creek	U.S. 70 Bridge	Cumberland	21.5
Daddys Creek	Meridian Bridge	Cumberland	27.0
Obed River	Adams Bridge	Morgan	25.1
Whites Creek	Old Lavender Bridge	Morgan	4.0
Whites Creek	Twin Bridges	Morgan	6.9

269 acres (108.9 hectares) of land which lie below the ordinary high water line. These lands are described as riverbed and include lands adjacent to:

- Obed River, south side, from western edge of Catoosa WMA to Alley Ford, approximately 23 miles (24.4 kilometers)
- Obed River, north side, from western edge of Catoosa WMA to river mile 15, approximately 9 miles (9.5 kilometers)
- Clear Creek, south side, from Morgan County line to river mile 13.5, approximately 4.5 miles (4.8 kilometers)
- Daddys Creek, both sides, entire length within the WSR

Other adjacent lands of the Obed WSR corridor occurring within the 79,740 acre (32,215 hectares) Catoosa Wildlife Management Area are owned and managed by TWRA and are managed in a manner compatible with the purposes outlined in the Wild and Scenic Rivers Act, as amended.

Private **Land Holdings**

- Private individuals and/or corporations own approximately 1,613.6 acres (653.0 hectares) within the WSR boundary. Twenty-nine tracts have river frontage and 30 tracts have either trail or vehicular access on or across the property. The Obed WSR Land Protection Plan, 1992, describes the strategy for purchasing non-federal lands, which lie within the official boundary, under the management authority of the NPS.

Private Land Holdings Having Federal Easements. An additional 1,066 acres (431.4 hectares) is privately owned, but subject to easements restricting land uses which might impact the Obed WSR. The rights purchased by the NPS vary slightly from tract to tract depending on location and topography. These easements are tailored to specific property, but generally:

- provide protection for the existing landscape character
- restrict advertising, dumping trash, and developing lands and new structures
- provide for public use along the river and floodplain
- prohibit road construction
- permit limited agriculture and timber practices on the rim while prohibiting these activities in the gorge
- prohibit animal operations with large populations

Major Land Disturbances and Uses Within the Obed WSR

National Park Service Activities

The NPS operates the park headquarters and visitors center in Wartburg. The main components of the NPS activities are internal maintenance and administration, resource management, interpretive programs, and visitor orientation and assistance. Construction and development of future facilities, include trail development and additional buildings. Recreational areas may have limited impacts on water quality due to sedimentation and land disturbance.

The NPS maintains picnic and restroom facilities in the floodplain areas at Nemo Bridge and Jell Bridge, and additional restroom facilities are planned for Barnett Bridge. Primitive camping is allowed at Nemo Bridge, and unrestricted camping occurs in other areas of the WSR. Human waste disposal and litter is a concern in these areas. During flood events, restroom facilities located in the floodplain at the above locations may overturn, and there is the potential for bacterial contamination of the adjacent stream.

Roadways and Bridges

The topography of the Obed/Emory River watershed has been a determining factor in roadway development. Because of the steep topography in much of the area within the Obed WSR, roads are often built paralleling the drainage patterns of the landscape. Access to the Obed WSR is limited. Highway 298, an east-west road, parallels the Obed River and Clear Creek and crosses the Obed WSR at Clear Creek and Jell Bridge. Other roadways which cross the Obed WSR include:
Catoosa Road at Nemo Bridge, Ridge Road crossing Clear Creek at Lilly Bridge, Firetower Road crossing Daddys Creek at the Obed WSR boundary with Catoosa Wildlife Management Area, Barnett Bridge Road crossing Clear Creek at Barnett Bridge and a bridge crossing the Obed River at Potters Ford. TOOT is scheduled to begin replacement of the existing Nemo Bridge in May of 1998. Construction activities and associated sedimentation due to bridge replacement may have an impact on water quality, if TOOT does not use proper BMPs during construction such as silt fences, check dams, and hay bales. Erosion from unimproved access roads and trails within the Obed WSR boundaries contributes to some sedimentation of its waterways.

Coal Mining

Although extensive coal mining exists in the Obed/Emory River watershed, there is no active coal mine operations in the Obed WSR. An abandoned deep mine is located on the eastern side of the Emory River approximately 0.5 mile (0.9 kilometer) upstream of Nemo Bridge and less than 1000 feet (305 meters) upslope from the river. There is a strip mine on the south side of the Obed River near Obed River mile 1, which has re-vegetated with scrub vegetation. A second abandoned strip mine is located on the north side of the Obed River, across from the strip mine site described above. It is located on property in the Obed WSR's proposed boundary area.

Oil and Gas

Tennessee's Division of Geology records the location of oil and gas operations on USGS 7.5 quadrangle topographic maps. These maps indicate there are seven oil and gas operations within the WSR boundaries. Four of these sites are active; three are indicated as abandoned. Two of the inactive operations are on federal land—one on the south side of Clear Creek, east of White Creek, and another northwest of Lilly Bridge. The other operations are located on lands not yet acquired but within the current boundary. Chemical and petroleum by-products of the production process from active operations and leakage from abandoned wells could impact water quality. Additional map and field analysis are needed to determine the exact location of the WSR boundaries with relation to the oil and gas operations.

Agriculture

Small-scale agriculture takes place on private lands back from the rim of the gorge where mixed hardwood-pine forests have been cleared for cropland. Illegal cultivation of marijuana does occur within the Obed WSR boundaries.

Grazing

Small-scale livestock operations occur on some privately held lands in the WSR where forested areas back from the rim of the gorge are cleared for grazing. Easements on some private lands prohibit livestock operations with large populations of animals.

Silviculture

A large portion of the lands included in the Obed WSR has been logged at some time in the past. Silvicultural activities do occur on privately owned lands, and TWRA may cut timber within the gorge only when necessary and after prior consultation with the NPS. Logging on private land may result in siltation of adjacent water bodies if stream-side buffer zones and logging haul roads are not properly maintained.

Off-road Vehicle Usage

NPS management policies and Title 36 Code of Federal Regulations, Section 4.10(b) prohibit ORV usage. Primitive roads and trails cross the WSR corridor in several places. ORV recreational users often use these primitive trails in violation of regulations. Negative impacts to water resources occur in the form of siltation from erosion caused by vehicular impacts on soil and vegetation, by grease and oil residues left by vehicles as they pass through or break down, and by litter or garbage left behind by the operators and passengers of ORVs.

External Land Uses

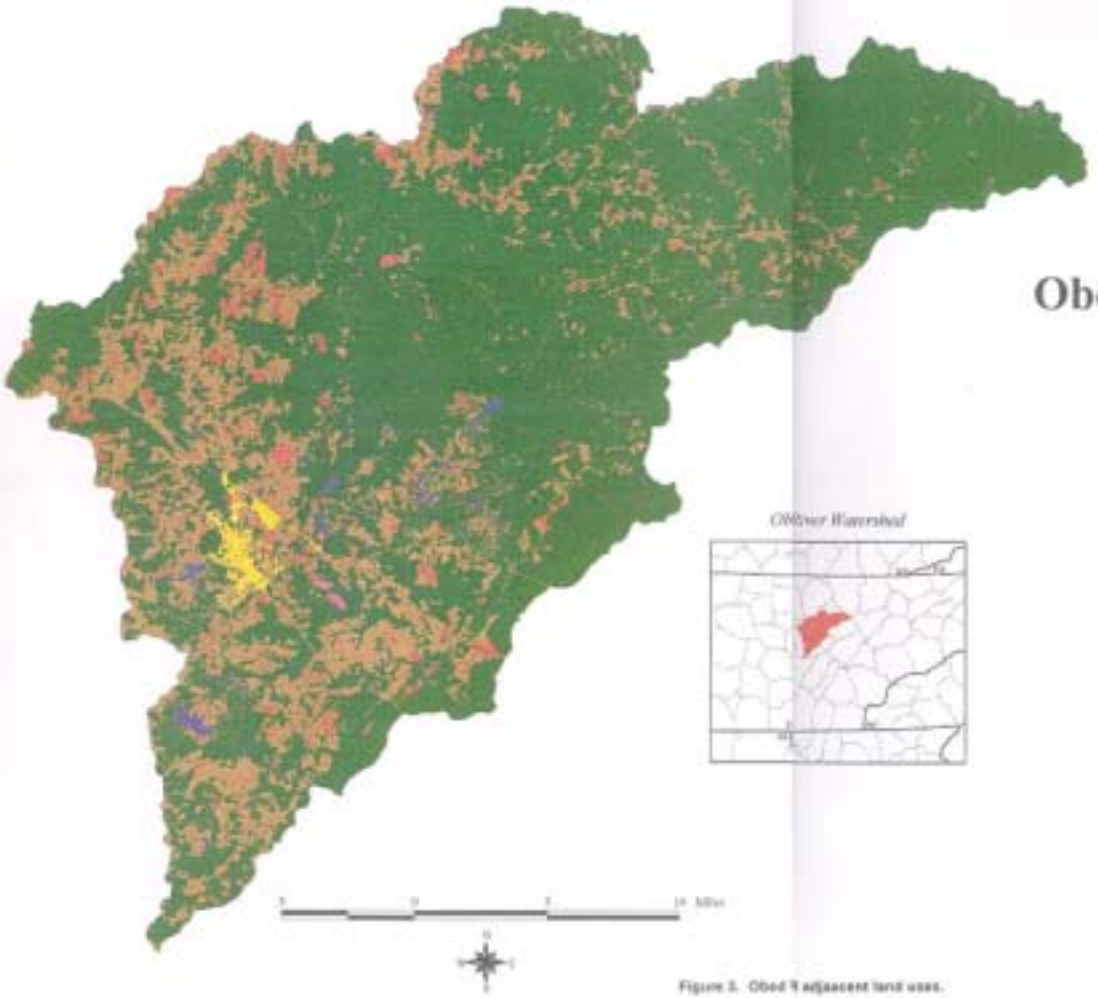
Agriculture

Topography and poor soils generally restrict agricultural land uses to the relatively level land of the Cumberland Plateau and western portions of Cumberland and Morgan counties. As shown in Figure 3, approximately 3 percent of the land area in the Obed/Emory River watershed is in agricultural production, primarily livestock production, corn, snap beans, and tobacco. Land use data compiled by Landsat Satellite Imagery in 1993 indicates at a coarse resolution, pasture areas comprise 25 percent of the land use in the Obed River and upper Emory River watershed. Runoff impacts from agriculture and livestock operations result in high levels of bacteria and elevated conductivity that threaten water quality conditions in the Obed WSR (Dixon, Natural Resources Conservation Service, personal communication). Agricultural BMPs to minimize impacts to water quality, such as fencing cattle out of streams and maintaining riparian buffer zones, are not widely used by landowners (Dixon, Natural Resources Conservation Service, personal communication).

Silviculture

Forested lands cover over 72 percent of the 0 bed/Emory River watershed. Silvicultural activities are primarily small-scale forestry operations managed by independent contractors, and average 50 acres (23.23 hectares) or less (Bible, Tennessee Department of Agriculture, Division of Forestry, personal communication). The primary harvesting method is selective cutting/selective regeneration (Arnold, Tennessee Department of Agriculture, Division of Forestry, personal communication). Large-scale industrial-type forestry operations (greater than 100 acres or 40.46 hectares), operated by forestry industries such as Bowater and Champion International exist in Morgan and Scott counties, but are not in the Obed/Emory River watershed (Bible, Tennessee Department of Agriculture, Division of Forestry, personal communication). No permits specific to silviculture are required by the State of Tennessee to harvest timber, but all forestry operations must adhere to TDEC water quality regulations. BMPs are utilized to limit water quality impacts such as stream-side buffer zones, and are voluntary. The State of Tennessee's Division of Forestry conducted a BMP implementation survey to assess how well BMPs are applied in various forestry operations. The findings of this survey have been published in a report entitled BMP Implementation Survey Report (TDEC 1996).

Some 150-200 acres of trees per year are harvested from Catoosa Wildlife Management Area. The majority of lands in Catoosa are clear-cut. Estimates by TVVRA indicate approximately 80 percent of the lands are left to naturally regenerate back to hardwood forests, while another 20 percent is converted to pine forests. Logging contractors working in TWRA's Catoosa Wildlife Management Area are required to be certified by Tennessee's Master Logger Program and use silvicultural BMPs set by the State of Tennessee to limit impacts to water quality. Despite the use of silvicultural best



Obed Wild and Scenic River
Adjacent Land Uses

- Open Water
- Pasture
- Agriculture
- Forest
- Urban
- Strip Mines

Landuse Class	Total Acres
Open Water	3641
Pasture	97036
Agriculture	7298
Forest	280741
Urban	2257
Strip Mines	665

Total Acres: 391,638
Total Square Miles: 612

Figure 3. Obed 9 adjacent land uses.

management practices, studies have found that high levels of suspended solids enter streams from unpaved logging/haul roads in the abed/Emory River watershed (Abbott 1982a), and it is expected that such impacts will continue.

Coal Mining

The SMCRA provides for the mining of coal in an environmentally sound manner, including the reclamation of mined lands. It was passed in 1977 and went into effect on May 3, 1978. Coal mining in the Obed/Emory River watershed has declined in the years following SMRCA (Waddle, USOSM, personal communication). The USOSM data indicate 18 coal mines are located in the Obed River watershed. Of those 18, two are listed as active. Disturbed areas range from 1-39 acres (0.4 .15.8 hectares). The USOSM lists 21 mines in the upper Emory River watershed, ranging in size from I .65 acres (0.4 .26.3 hectares). However, data does not indicate which of these mines are active or abandoned. A coal mine currently being permitted in the Island Creek watershed (Permit No. 2981) poses a potential threat to Emory River water quality. USOSM personnel indicate that this mine is permitted to operate through September 10, 2002 (Walker, USOSM, personal communication). Personnel from TDEC's Mining Section and the USFWS plan to conduct semiannual surveys to assess water quality impacts as a result of this mine (Turner, TDEC, personal communication).

Both state and federal regulations attempt to minimize impacts to water quality associated with any coal mining activities. Mine operators must adhere to Tennessee's Water Quality Control Act and the Federal Water Quality Act, which require NPDES permits to manage storm water, as well as minimization of any water quality impacts due to toxic leacheates/acid mine drainage. Despite such regulations, studies have shown high levels of suspended solids from unpaved haul roads and toxic leacheates due to acid mine drainage have impacted the lower Obed River, Island Creek, and Rock Creek (Abbott 1979; Abbott 1982a; Spradlin 1993).

Oil and Gas

Information provided by the State of Tennessee's Division of Geology indicates there are 944 oil and gas wells in the entire Emory River basin. This includes both active and abandoned wells. Due to economic reasons, oil and gas operations are not as active in the abed/Emory River watershed area as in the past, but an increase in oil and gas prices could accelerate additional exploration (Hoyal, TDEC, personal communication). Oil and gas operations use brine solutions, oil, acids, sudsing agents, and other chemicals during the drill and production processes. These chemicals can impact water quality through spills, releases, and overflows; such incidents are difficult to locate and document as they are sporadic and isolated incidents. The erosion and subsequent sedimentation from the land clearing and road construction association with mining activities also impact water quality (Rikard 1985).

Quarries/Other Mineral Extraction

Quarry areas in the abed/Emory River watershed primarily mine fieldstone and Crab Orchard stone. These operations are typically small (less that 10 acres or 4.0 hectares) and are a minimal problem with regards to water quality (Turner, TDEC, personal communication). Sand mining also occurs in limited areas of the watershed; two mines are located on a tributary to Island Creek. Some limited impacts due to sedimentation occur due to these mines (Turner, TDEC, personal communication).

Residential and Commercial Development

Increased residential and commercial development in the Obed/Emory River watershed presents an external threat to the water quality and quantity in the Obed WSR. Population in Cumberland County has grown by 13 percent from 1990-1 995, and growth is expected to continue based on current trends. Two significant residential developments are Fairfield Glade, located along Otter Creek (a tributary to the Obed), and the Lake Tansi development along Byrd and Basses Creeks in the Daddys Creek watershed. These creeks have been impacted by siltation from

construction activities due to residential development. Commercial and residential development in Fentress and Morgan Counties lags behind that of Cumberland County, though there is some scattered residential development in Fentress County along Clarkrange Highway. There are no local zoning or engineering regulations dictating storm water management with regard to residential and subdivision development in Fentress, Morgan, or Cumberland counties. In all areas of the Obed River and upper Emory River watersheds, increased residential development and associated water quality impacts from septic tanks and drain fields will increase.

Industrial Development

Two industrial parks in the Crossville area are being developed. The Davis Road Park consists of 189 acres (76.5 hectares), and will include a mixed use of both recreational sites for picnicking and hiking, as well as industrial sites. A 70 acre (28.3 hectares) park is located on Genesis Road in Crossville near Interstate 40. Construction activities related to industrial park development may have localized impacts on water quality, if construction BMPs are not used. Industrial development in Fentress and Morgan Counties lags behind that of Cumberland County due to lack of interstate highway access.

Increased commercial and industrial development results in replacing or modifying existing land surface cover (e.g., vegetation) with roads, roofs, driveways, and other impervious material. The increase in impervious surface cover increases the amount, speed, and frequency of runoff from storms, as infiltration is decreased. The changes in land use also result in runoff carrying greater pollutant loadings of urban non-point source pollution into receiving streams in the watershed.

Planning Considerations

Administrative actions of the NPS and other agencies that address the issues raised in the WRMP are required for implementation of the WRMP objectives. Planning considerations regarding NPS activities and funding, interagency coordination, and regulatory issues
relate to water resource planning for the Obed

WSR.

National Park Service

Public attitudes in support of the actions of Obed WSR are vital to ensure protection of water resources. Though there is local support for NPS land acquisition and easements, landowners do not often agree with NPS land acquisition purchase prices. Vandalism of NPS facilities and signs is a sporadic problem.

Additional planning issues are related to limited Obed WSR staff and funding. Presently the WSR has limited staff and funding to administer NPS activities and protect the resources of the WSR. The WSR is staffed by four full-time employees that includes: a Superintendent, Administrative Officer, Maintenance staff person, and one Protection Ranger. Three part-time positions, including two interpreters and one protection ranger are hired seasonally to provide additional support. Annual funding is $250,000—one of the lowest for any NPS unit.

Inter-agency Coordination

Other state and federal agencies address water quality and water resource issues in the Obed/Emory River watershed. The TOEC's Water Pollution Control Division is in the initial stages of implementing a watershed approach to water quality monitoring, NPDES permitting, and municipal and industrial discharge permitting. The Emory River watershed will be one of the first watersheds in the state to be regulated and monitored in this way. NPS coordination with TDEC to obtain monitoring data, information regarding permitting activities in the watershed, and other water resource protection efforts is an important step to implementing objectives of the WRMP.

TVA's Clean Water Initiative has established a River Action Team (RAT) in the Ft. Loudoun/Melton Hill/Watts Bar watershed, of which the WSR is a part. The RAT conducts water quality and biological monitoring of water resources in the abed/Emory River watershed, implements water resource improvement projects, and works to build inter-agency and community support for water quality improvement activities and resource

protection. Working actively with the RAT may allow the NPS to gain additional information about resource conditions and aquatic communities and diversity, as well as increase public education and support of the

WSR.

Other agencies conduct water resource-related activities in the abed/Emory River watershed. NRCS staff are actively involved in agricultural land use assessment, monitoring, and management. A working relationship between the NPS and NRCS is important, especially with regards to promoting agricultural best-management practices to reduce the impact of livestock and farming activities on water quality. The USGS National Water Quality Assessment (NAWQA) Program has chosen the Obed River as one of its 59 national study units, and will be collecting detailed stream flow and water quality data. TDEC's Division of Surface Mining (in cooperation with the USFWS) is coordinating an ecological assessment program of streams located in mined areas in the Obed River watershed. The program is expected to provide valuable ecological data that can be used by the NPS in making water resource planning decisions and assessing potential impacts of mining activities on the ecological health of the overall watershed.

Regulatory Issues

Various regulatory issues need to be considered when addressing long-term protection of the water resources of the WSR. Land use planning, zoning regulations, storm water management guidelines, definition of water rights, and stream-side buffer zone protection all have the potential to protect, preserve, and in some cases improve water resource conditions in the abed/Emory River watershed. State and local governments, county planning commissions, industrial boards, economic development agencies, and various other entities deal with these issues. There is a need to communicate to these agencies the economic importance of preserving the integrity of the WSR, and to implement voluntary incentives to reduce the impact of non-point source pollution from increased land use conversion and resource extraction activities. It is unlikely, given economic and political considerations, that
additional regulations will be enacted. Voluntary incentives and public education, however, are likely over time to make an impact on reducing the impact of non-point source pollution, if a coordinated effort is made to emphasize the importance of the Obed WSR to the regional economy and its uniqueness as a natural resource.

The Hydrologic environment

Introduction

This section reviews the hydrologic setting of the Obed WSR. Water is the principal resource of the Obed WSR. Without it and ensuing processes, the resources for which the Obed Wild and Scenic River System is valued would not exist. Lands drained by the Obed River, Daddys Creek, Clear Creek, and the upper Emory River form the watershed for the Obed WSR. It is important to examine the entire watershed since most factors affecting the Obed WSR's water resources occur outside of its boundaries. A description of the area follows which includes physiography, soil, geology, climate, and other factors affecting surface and groundwater flows and water quality.

Description of the Watershed

Physiography

Cumberland, Morgan, and Fentress counties which encompass the Obed WSR National Park Service Unit lie in the Cumberland Plateau physiographic province of Tennessee (Figure 4). The terrain on the plateau is distinguished by flat to rolling upland areas (less than 10 percent slope), deeply incised river gorges, and a long line of cliffs that separate it from the lower elevations of the Ridge and Valley Province. In the northeastern portion of the upper Emory River (which makes up the northeast portion of the Obed WSR watershed), the terrain is more mountainous. The area is drained by a dendritic (fan-shaped) system of streams that flow through the narrow valleys.

Elevations in the watershed range from over 3000 feet (915 meters) above mean sea level (MSL) in the mountainous upper Emory River watershed to approximately 850 feet (259 meters) MSL at Nemo Bridge, the downstream end of the Obed WSR. Most of the Obed WSR is influenced by the rolling uplands on the plateau that exhibits a gentle regional slope, varying from about 2000 feet (610 meters) MSL near Crossville to 1300 feet (396 meters) MSL at Wartburg. Elevations along the lands bordering the streams within the Obed WSR vary from 900 to 1500 feet (274 to 457 meters) MSL. Some gorge sections are quite narrow, only 800 feet (242 meters) across, and have near vertical sides, up to 400 feet (121 meters) high.

The four principal streams of the watershed, the Obed River, Clear Creek, Daddys Creek, and the upper Emory River, drain approximately 615 square miles (1,593 square kilometers) in Cumberland, Morgan, and Fentress Counties. These high gradient streams are similar to most other streams on the Cumberland Plateau. Stream gradients, with drops averaging 19 feet (5.7 meters) to 34 feet (10.4 meters) per mile, are steepest in downstream sections. They have a distinct meander pattern, developed on a higher surface when the streams had reached a temporary base level (perhaps on the resistant Rockcastle Conglomerate). Table 4 lists the major streams and their drainage areas at selected locations.

Table 4. Drainage Area at Selected Locations.

	Square Mile
Emory River	
Mile 27.7, Near Nemo	612
Mile 28.4, Above Obed River	91
Obed River	
Mile 0.0, Mouth	520
Mile 1.4, Former Stream Gage near Lancing	518
Mile 4.4, Above clear Creek	339
Mile 9.1, Above Daddy Creek	156
Clear Creek	
Mile 0.0, Mouth	173
Mile 4.1, Jett Bridge	153
Daddy Creek	
Mile 0.0, Mouth	175
Mile 9.1, Former Stream Gage near Hebbertsburg	139

Only a short reach of the Emory River is located within the Obed WSR boundaries. That reach extends from the Emory River's confluence with the Obed River, mile 28.4, to

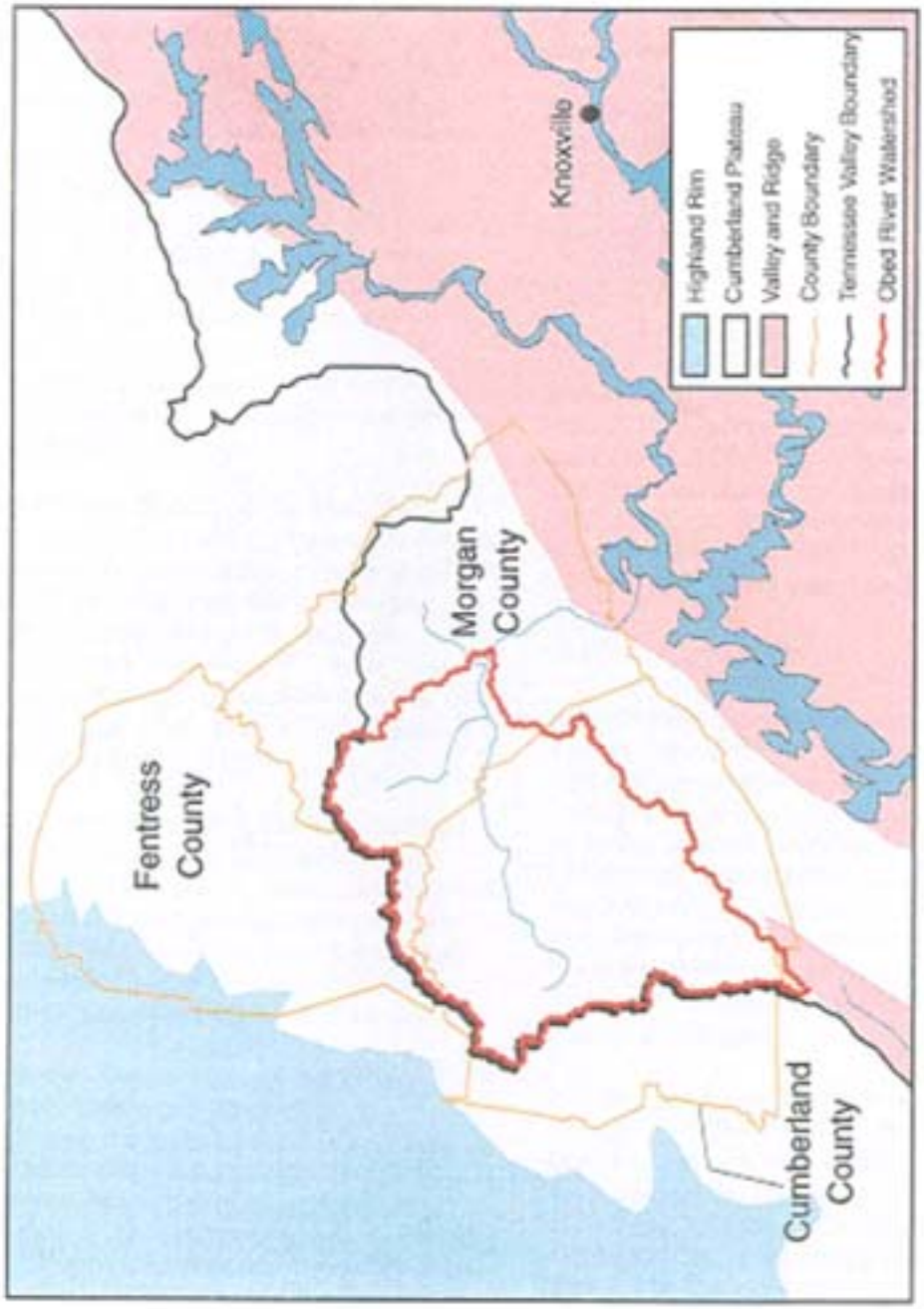


Figure 4. Physiographic location of the Obed River Watershed.

Nemo Bridge, mile 27.7. Above mile 28.4 the Emory River drains an area of 91 square miles (3235.7 square kilometers). Its headwaters are located in northeastern Morgan County that exhibits some of the most rugged terrain found in this region.

The Obed River is the largest tributary of the Emory River and has a total drainage area of 520 square miles (1,295 square kilometers). Its headwaters are located a few miles northwest of Crossville and the stream flows easterly through a narrow valley toward its junction with the Emory River. The two principal tributaries, Clear Creek and Daddys Creek, join the Obed a few miles above its mouth. Little damage is suffered from floods on the Obed River because of the nature of the terrain and the fact that there is little development or farming near the stream. Damage to highways and bridges constitute the chief item of damage.

In the northwest portion of the watershed lies the 173 square mile (448.1 square kilometers) area drained by Clear Creek. The stream flows north easterly from its source near Campbell Junction to a point near the Fentress-Cumberland-Morgan county line, then southeasterly to its junction with the Obed River about four miles above the junction of the Obed and Emory Rivers.

Daddys Creek, the largest tributary of Obed River, drains an area of 175 square miles (453.3 square kilometers). Its headwaters are located south of the Cumberland Homesteads, near Crossville. From there the creek flows northeasterly to its junction with the Obed River about nine miles above the mouth.

The average stream slope of the Emory River in the reach within the Obed WSR is approximately 13 feet per mile. On Clear Creek, the average slope in the 15-mile reach investigated, Mile 0.00 to Mile 14.68, is approximately 22 feet per mile with the slope varying from 6 to 52 feet per mile. The slope of the stream on Daddys Creek in the 9-mile reach investigated, Mile 0.00 to Mile 9.10, averages approximately 39 feet per mile and varies from 17 to 70 feet per mile.

Soils

Soils of the Cumbertand Plateau are primarily derived from sandstone, shale, and siltstone. These are predominantly loamy soils with moderate infiltration rates. Soil depths of less than I to 5 feet (0.3 to 1.5 meters) occur over most of the plateau such that overburden soil rarely serves as a source of groundwater in upland areas. Along the steep slopes of the mountains and escarpment, soil depths might range from 1 to 2 feet (0.3 to 0.6 meters) near the top to 7 feet (2.1 meters) on the slopes. The erosion potential on the slopes is great and can be severe if vegetation is removed.

Deposits at the foot of the Cumberland Plateau escarpment consist of a mixture of coarse, weathered rock and soil derived primarily from upland Pennsylvanian caprocks and Mississippian limestones. These deposits are a mixture of materials ranging from boulder-size sandstone blocks to colluvium and alluvium. Extensive areas of Quatemary alluvium and colluvium from the caprock cover flatter areas near the escarpment base.

Geomorphology

All of middle Tennessee was at one time capped by a thick sequence of Pennsylvanian sandstones, conglomerates, and shales. Today, only in the Cumberland Plateau area does the caprock continue to protect the underlying Mississippian limestones from relatively rapid dissolution. The present topography has been formed by continuous lowering of the surface by erosion, a process that involves slope retreat on beds of different resistance (Figure 5).

Pennsylvanian sandstones were removed by erosion from the Central Part of the Nashville Dome (structural high along the Cincinnati Arch) during the Mesozoic Era and the underlying Mississippian limestones were exposed. Slope retreat by limestone dissolution then began forming an escarpment and initiated its subsequent retreat in all directions away from the dome (Crawford 1982). Erosion continued both downward and outward and a plain-like surface developed

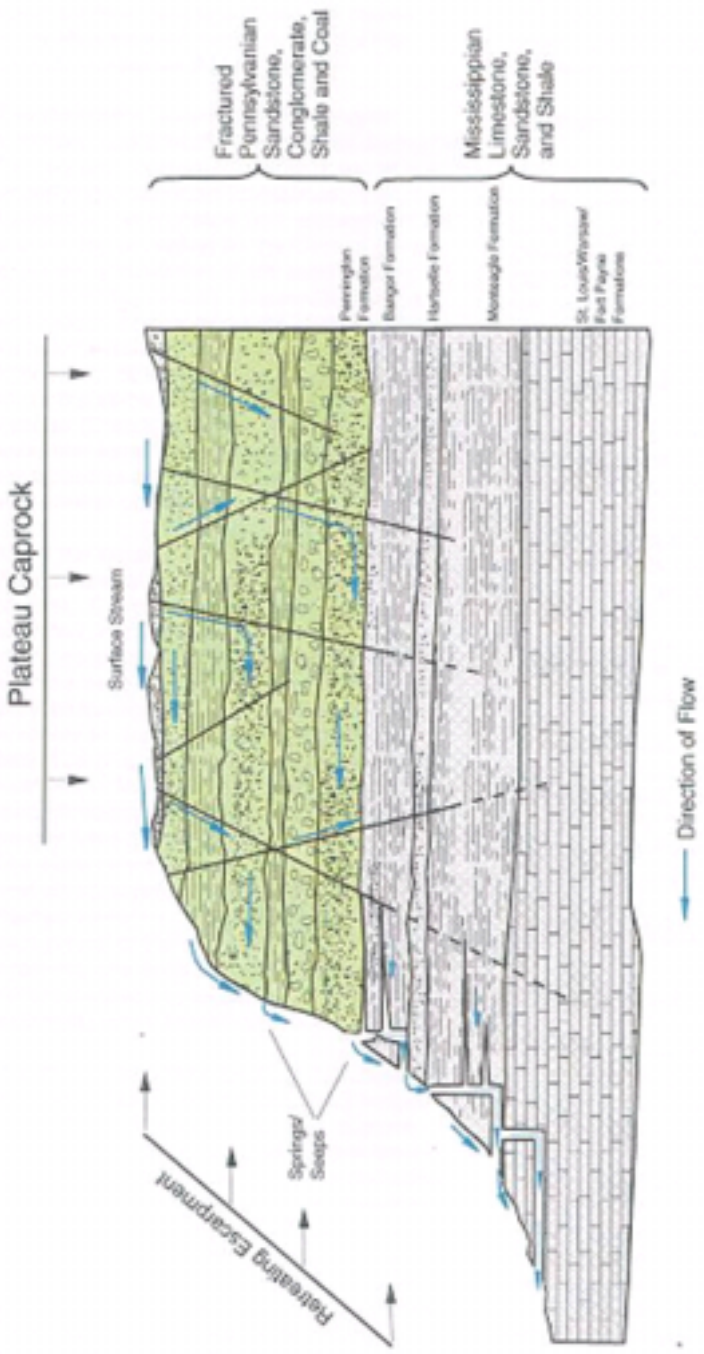


Figure 5. Conceptual section through Cumberland Plateau showing potential avenues of water movement.

upon the more cherty and erosion resistant lower Mississippian rocks during the late Cretaceous period (Miller 1974).

The resistant Mississippian Fort Payne formation was breached by erosion during the Tertiary and Quaternary Periods, exposing the underlying Ordovician limestones. This resulted in the Highland Rim escarpment that is presently retreating as the Central Basin expands. Dissolution of the underlying limestones is primarily responsible for the steep slope angles along the Highland Rim and Cumberland Plateau escarpments. Apparently, stream erosion is occurring at about the same rate along the Cumberland Plateau (Crawford 1982). Abundant caves and other karst features associated with both escarpments appear to have formed under very similar conditions.

Along the escarpments of the Cumberland Plateau are rather narrow but important areas of karst. Caves and karst features are abundant in this region, with most of the larger caves occurring in the Monteagle limestone near the base of the escarpment. The base of the escarpment usually corresponds to an area of cherty St. Louis limestone and Warsaw formation (Figure 5). Maps of reported cave locations in Middle Tennessee show highest concentrations of caves along two somewhat parallel lines that trend northeast-southwest. The easternmost line corresponds with the western escarpment of the Cumberland Plateau while the other corresponds with the escarpment of the Highland Rim. In both locations, one finds a similar relationship between erosion resistant caprock and underlying weak limestones.

The strata along the retreating Cumberland escarpment are rarely horizontal. There is also a strong correlation between caprock removal by slope retreat and conduit cave systems. Conduit caves along the escarpment result primarily from subterranean invasion of surface streams flowing off of the plateau (Figure 5). This invasion usually occurs near the contact between the overlying Pennington formation and underlying Bangor Limestone. Water usually resurfaces on top of the resistant Hartselle formation halfway down the escarpment and reenters the underlying Monteagle limestone. Where the local dip is toward the escarpment, caprock removal may often be accelerated by subterranean stream invasion occurring several miles behind the retreating escarpment.

Climate

The climate in the region is humid with moderate temperatures. A frost-free season lasts about 180 days from late April to late October. Temperatures reach or exceed 90° F (32° C) about 75 days per year and winter temperatures seldom drop below -5° F (-21° C) (NPS 1995). Yearly, the Cumberland Plateau receives about 52 inches (132 centimeters) of precipitation (NPS 1995).

Precipitation is distributed throughout the year with the highest amounts occurring in the winter and early spring. Figure 6 displays the average mean monthly rainfall recorded at five rain gages in or near the WSR. Rainfall associated with severe summer thunderstorms can be heavy and tornadoes occasionally occur on the plateau. Short summer droughts occur but severe droughts are rare. The driest periods occur in the autumn from September through November.

Evaporation and water loss from biological activities and processes on the plateau is less than in adjacent watersheds. Short summer droughts occur but severe droughts are rare. Normally, the driest periods occur in the autumn from September through November.

Surface Water Resources

Stream Flows

Stream flows are determined by rainfall and runoff patterns, groundwater recharge, and flow alterations occurring in the watershed. Like other streams on the plateau, the Obed River and its tributaries have their highest flows during the winter and spring. Low flow periods normally occur in summer and early autumn, when upper reaches of the river system resemble intermittent streams in which pools form with little or no flow between them. Figure 7 shows the difference in average flows throughout the year based on long-term recorded stream flow for the Emory River at Oakdale, Tennessee.

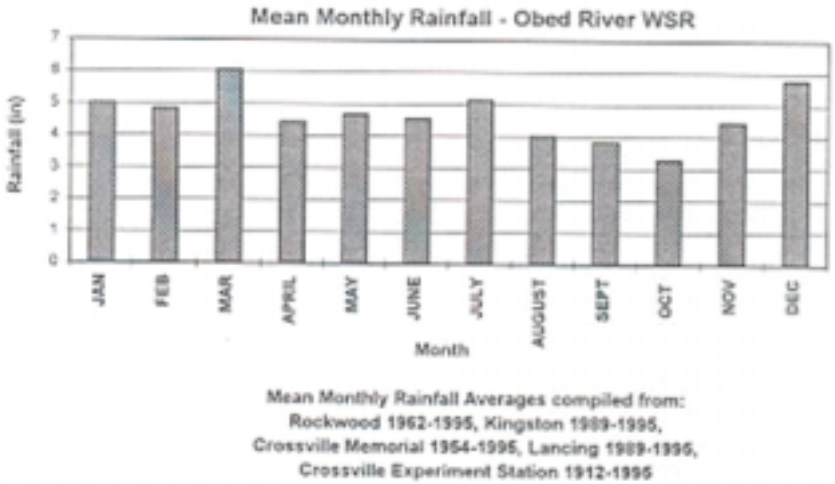


Figure 6. Mean Monthly Rainfall.

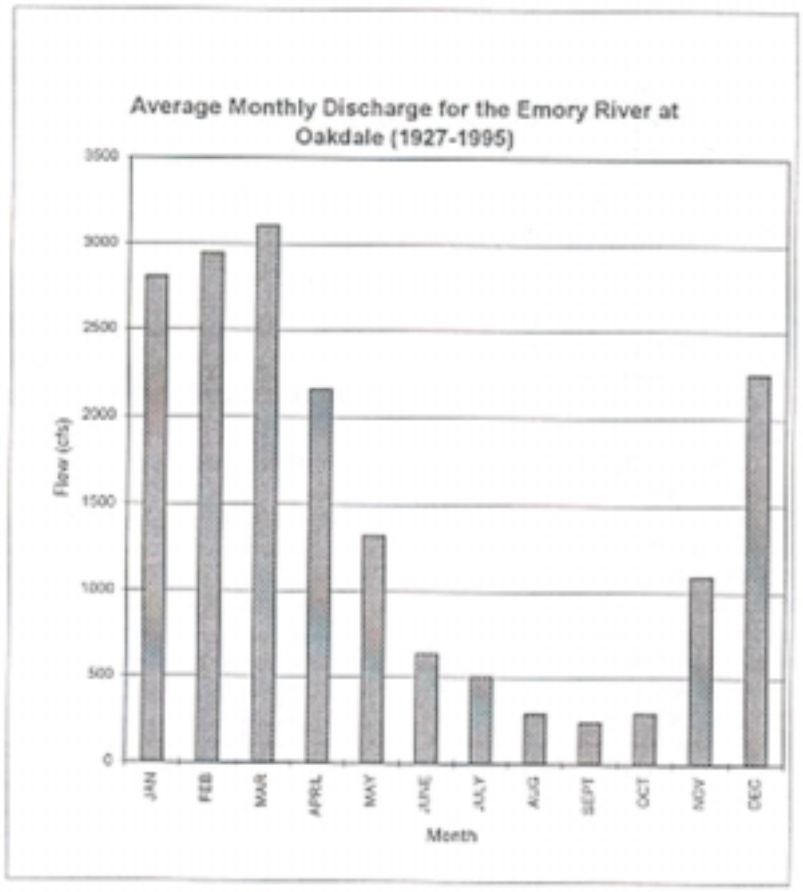
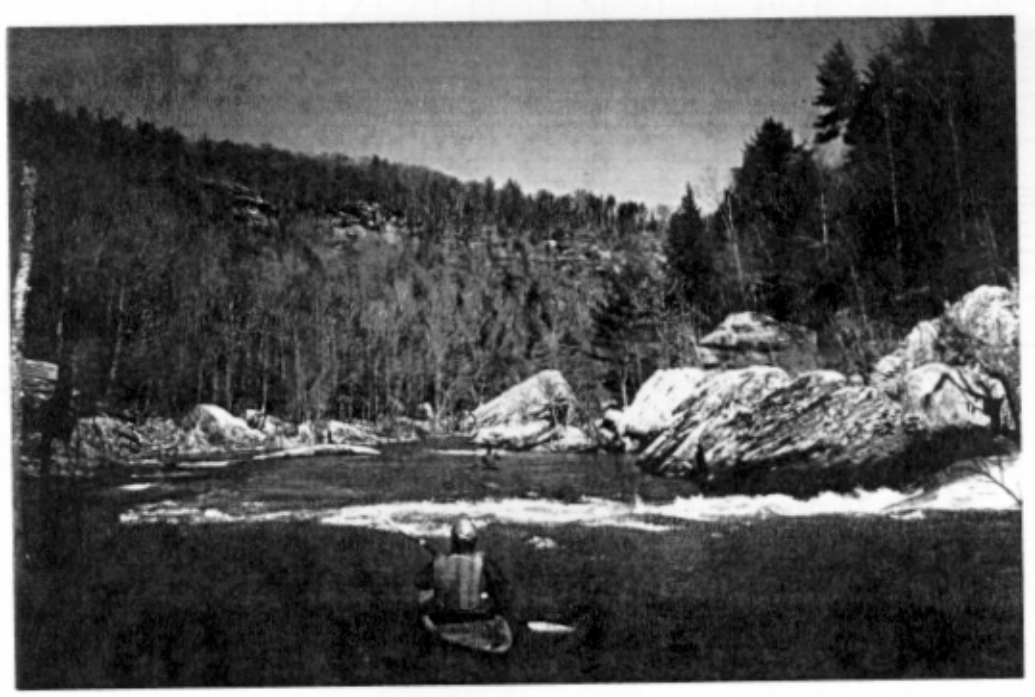


Figure 7. Difference in Average Flows for the Emory River at Oakdale, Tennessee.

The existing potential for high flows during storm events and extremely low flows during dry seasons create a wide range of flows in the Obed WSR streams. Stream flows on the Emory River at Oakdale, Tennessee, have been measured from nearly 0 cubic feet/second (cfs) to more than 190,000 cfs, as recorded in March of 1929. Figure 8 shows the percent of time that a given discharge is equaled or exceeded on the Emory River at Oakdale (Plotted from data compiled in “Flow Duration and Low Flows of Tennessee Streams Through 1992, U.S. Geological Survey 1996”). Figure 9 illustrates the percent of time that a given mean daily discharge is equaled or exceeded on the Obed River at the former stream gage location near Lancing (Plotted from Data compiled in “Flow Duration and Low Flows of Tennessee Streams
Through 1992 U.S. Geological Survey 1996”). Both Figures 8 and 9 illustrate the wide variation in flows that occur in the abed/Emory system. One example for Figure 8 is that 10 percent of the time, flow in the Obed River at Lancing is greater than 2500 cfs, and 10 percent of the time, flow is less that 20 cfs.

Flooding typically occurs within the watershed due to long, wet periods in winter and spring that saturate the soil, increasing runoff and ca using high water levels in the streams. Intense summer downpours can also occur which result in flash floods during this low flow period. Figure 10 is a graph showing flood peaks that have occurred on the Emory River at Oakdale from 1928 through 1994. All flows greater than 20,000 cfs that had occurred



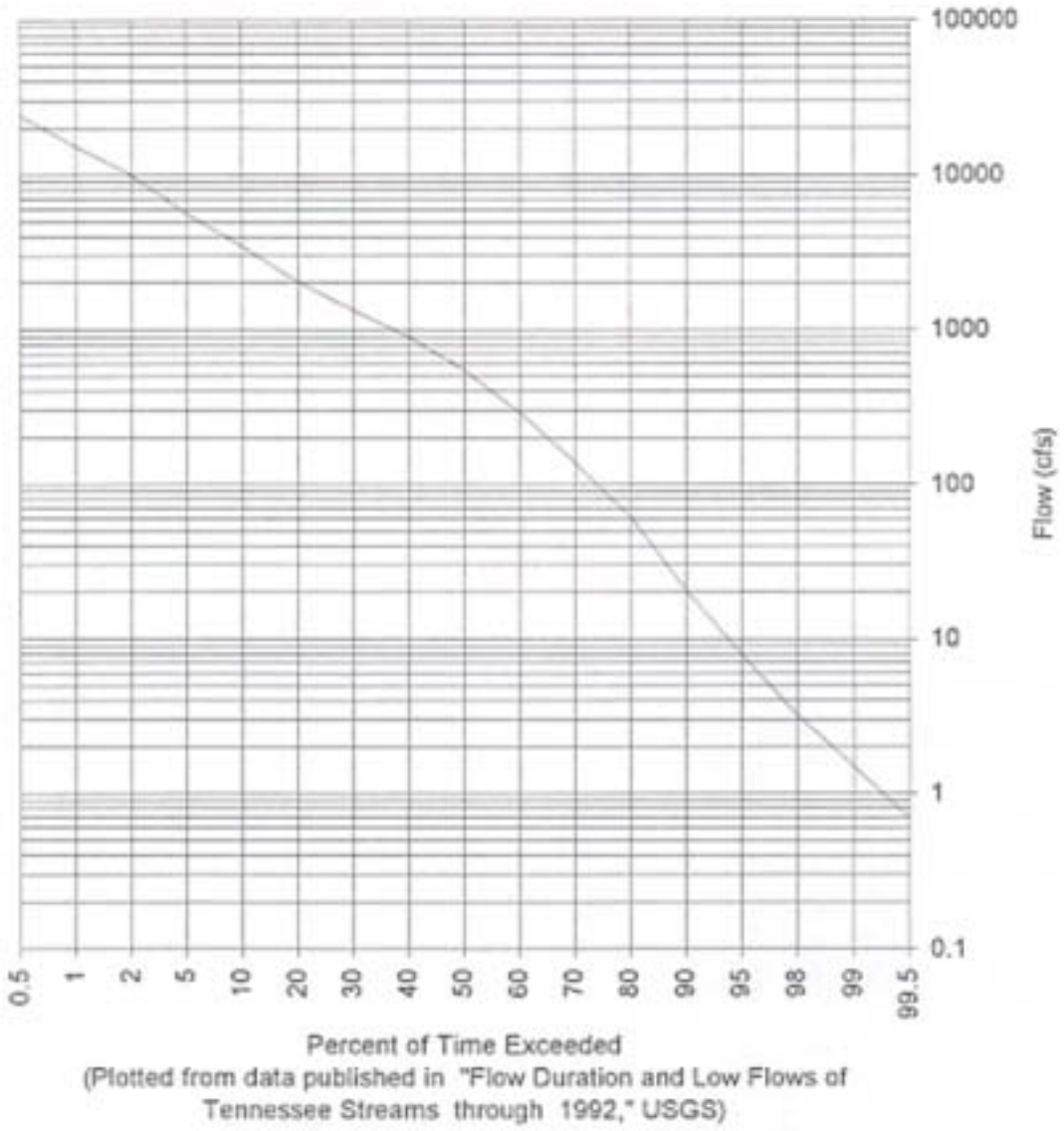


Figure 8. Percent of time exceeded, Emory River at Oakdale.

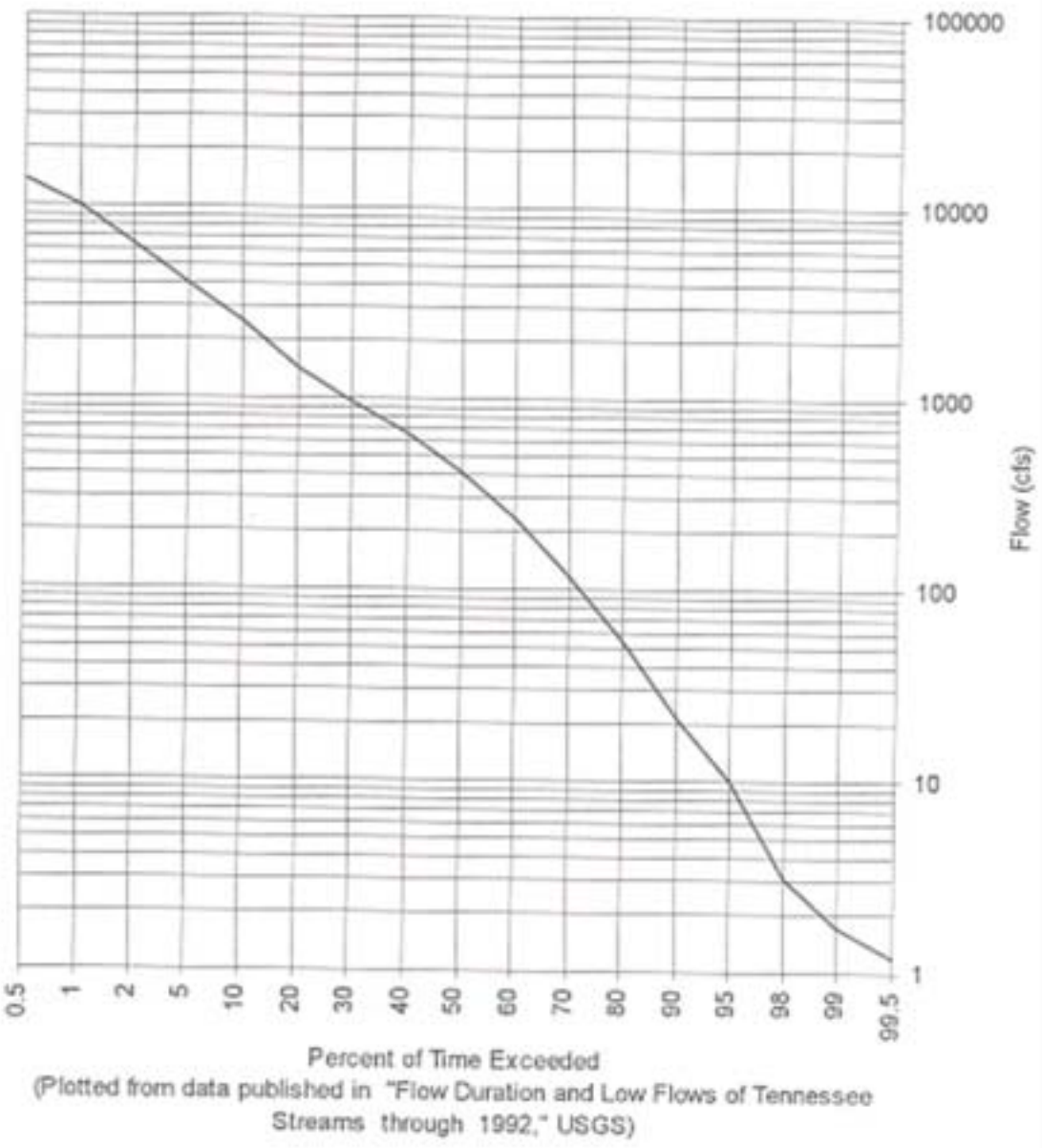


Figure 9. Percent of time exceeded, Obed River near Lancing.

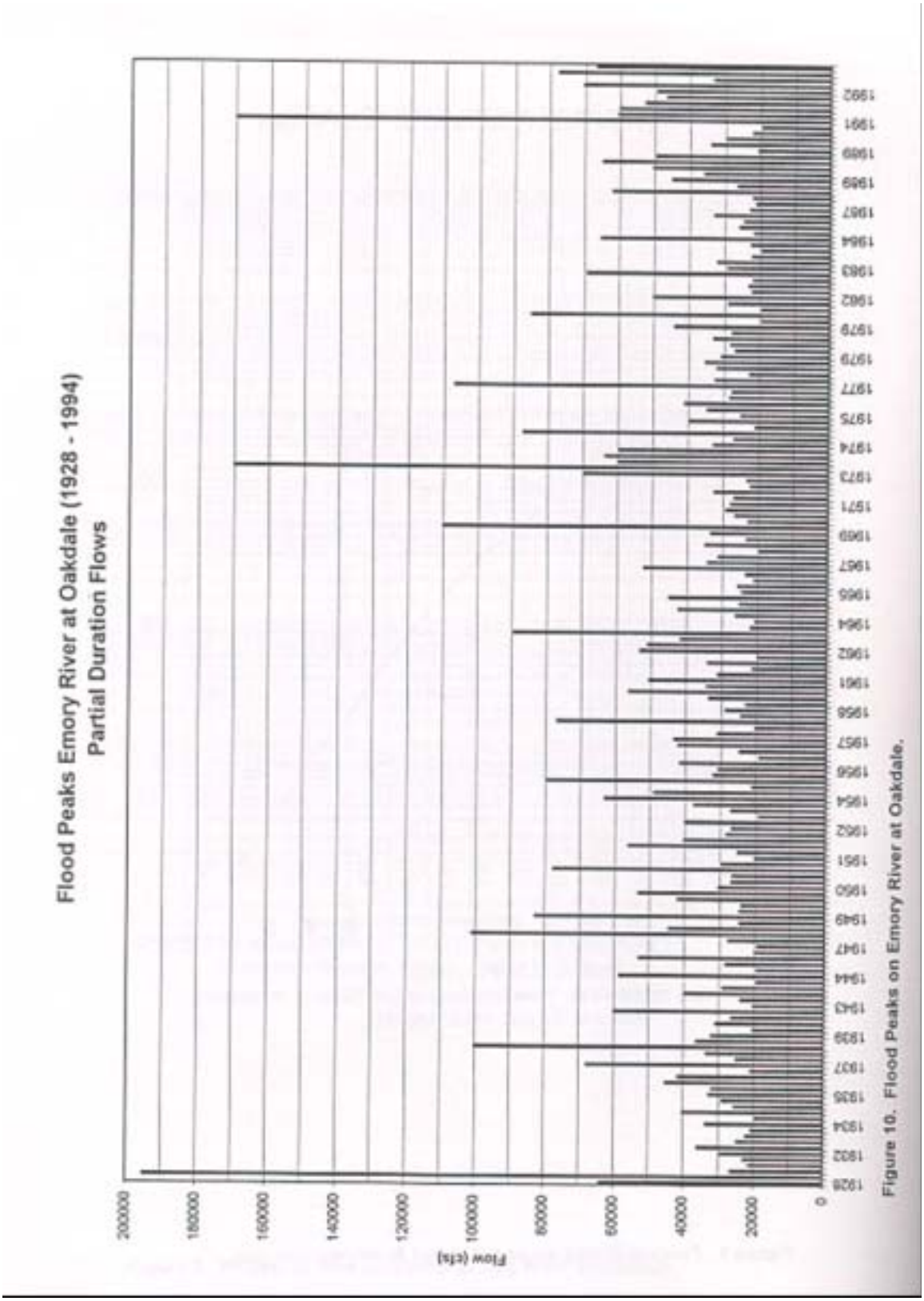


Figure 10. Flood Peaks on Emory River at Oakdale.

since 1928 are shown. As the graph shows, sixteen floods with peak flows over 70,000 cfs were recorded at the Oakdale gaging station between 1928 and 1994. Eighty percent of these floods have occurred between December and April.

Although stream flow data recorded at the Obed River at Lancing and the Emory River at Oakdale gages is the most widely used, several other gages have been in place or are currently in existence on streams in the Obed WSR. Table 5 lists these stream gages; Figure 11 depicts the location of stream gages.

Impoundments

Since the designation of the Obed WSR, NPS staff have been concerned that the construction of water supply and recreational use reservoirs on the Obed River and its principal tributaries may significantly lower summer stream flows in the Obed WSR and impair water-related resource attributes. This concern arises from not only the consequences of altered stream flow to the Obed WSR but the NPS mandate to preserve the free-flowing condition and outstandingly remarkable values of the Obed WSR as provided in the Wild and Scenic Rivers Act (16 U.S.C. 1271-1287) as well.

Table 5. Stream Gage Information.

Gage **Name / Location**	**USGS Stream Gage Numbers**	**Period** of Record on Base Map	Gage Type	**Located**
Emory River near Wartburg	03538500	1934-1957	Recorder	X
		1958-1 967	Crest Gage	
		1966-1968	Recorder	
		1969-1 982	Crest Gage	
Emory River at Dearmont	03540000 Estimate	1920-1 927	Recorder	1929
Emory River at Oakdale	03540500	1927-present	Recorder	X
Obed River at Crossville	03538600	1955-1 985	Crest Gage	
		1991-1995	Recorder	
Obed River near Lancing	03539800	1956-1 968	Recorder	X
		1973-1988	Recorder	
Obed River Trib. near Crossville	03538800	1955-1 970	Crest Gage	
Little Obed River near Crossville	03538700	1955-1 967	Crest Gage	
		1970	Crest Gage	
Byrd Creek near Crossville	03539100	1968-1 975	Crest Gage	
Daddys Creek near Grassy Cove	03539000	1925-1 927	Tape Gage	
		1927-1 930	Staff Gage	
Daddys Creek near Crab Orchard	03539500	1930-1 934	Staff Gage	
		1934-1958	Recorder	
Daddys Creek near Hebbertsburg	03539600	1957-1 968	Recorder	X
Rock Creek near Sunbright	03538300	1955-1 971	Crest Gage	
Self Creek near Big Lick	03538900	1968-1 985	Crest Gage	
Lick Creek at Big Lick	03538950	1968-1 973	Crest Gage	
Bitter Creek near Wartburg	03541000	1967-1969	Crest Gage	
Bitter Creek near Camp Austin	03541100	1967-1 985	Crest Gage	
Bitter Creek near Oakdale	03541300	1967-1 975	Recorder	
Forked Creek near Oakdale	03541200	19671975	Crest Gage	

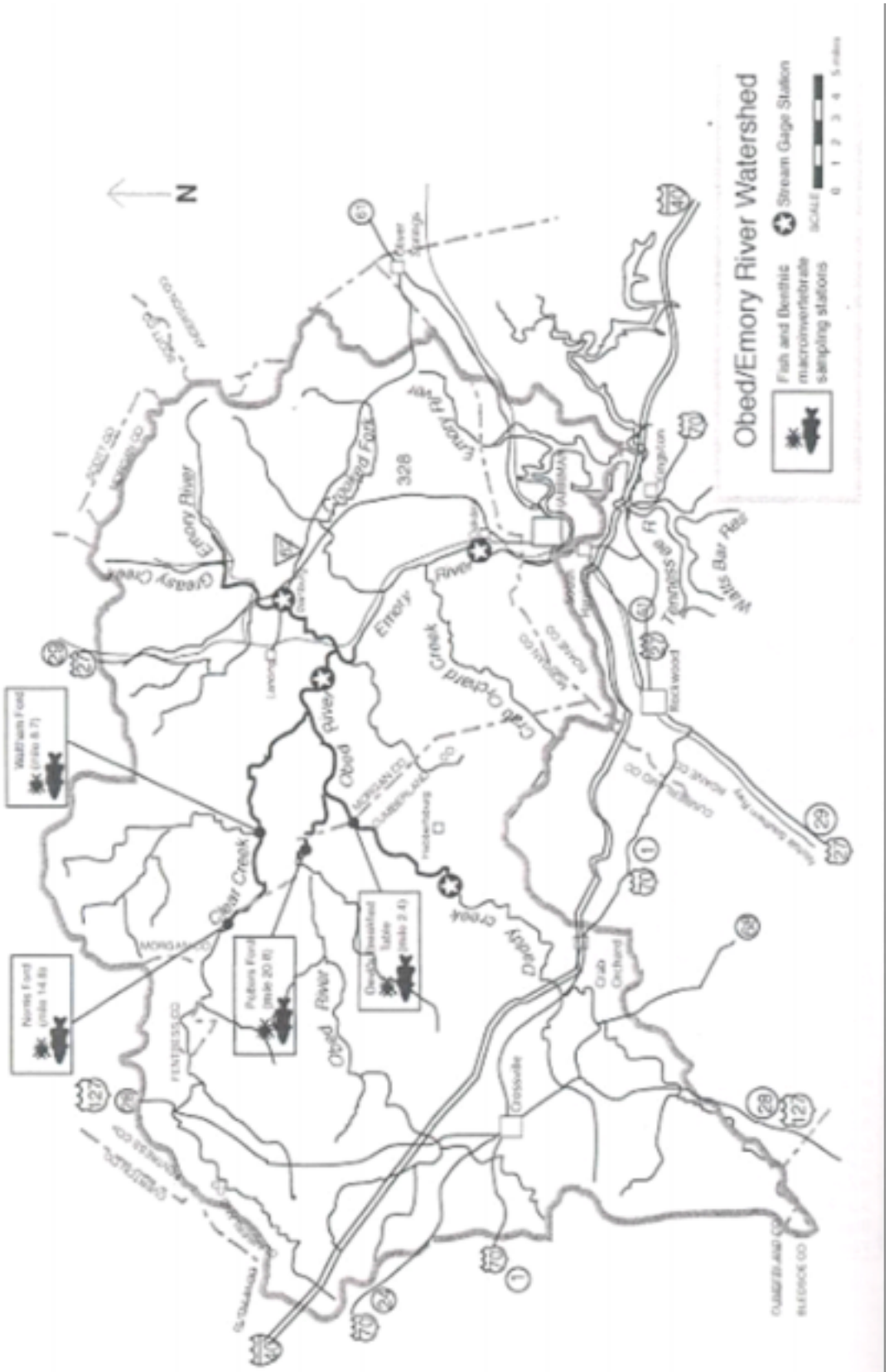


Figure 11. Locations of past and present stream gage stations.

It is a generally accepted fact that stream regulation reduces natural physical and biological variability and promotes conditions of constancy within a stream system. Within the Obed River watershed, numerous ponds and water supply impoundments exist on several tributaries upstream of the Obed WSR. It is possible that natural flows within the Obed WSR have been altered due to the individual and/or cumulative effects of stream flow impoundment in the watershed. The lack of comprehensive planning and management has allowed for the development of impoundments in the Obed River watershed and demonstrates the need for basin wide/regional comprehensive water resource planning.

The number of impoundments in the Obed River watershed has increased rapidly since 1943. As shown in Figure 12 (located in back cover pocket), in the period between 1943 and 1946, 388 impoundments were added to the watershed for a total surface area 522 acres (211 hectares). From 1976to 1987, 748 impoundments were added. During the period from 1988 to 1994, 1767 impoundments were constructed in the Obed River watershed. The total number of impoundments constructed from 1943 to 1994 is 2903, for a total surface area of 3818 acres (1542 hectares). Of these, 42 reservoirs larger than 2 acres (0.8 hectares) in surface area have been identified. According to the NPS's 1993 Dams Inventory Report, 14 of these impoundments are more than 50 acre feet in size. Some of the biggest lakes in the watershed are: Lake Tansi, Brown Creek Lake, Fox Creek Lake, Dartmoore Lake and Lake Holiday.

The USACE and/or WA have prepared six studies examining the possibility of damming streams in the watershed since 1932. None were constructed because they were cost prohibitive, offered poor recreational opportunities, provided only minimal flood storage, or would destroy aesthetic resources. At this time, there are no known plans to proceed with any of these projects.

Existing Impoundments. From Lake Holiday, the city of Crossville operates a 3 million gallon per day (MGD) intake for its water treatment plant. This water source currently meets the city's domestic needs. However, a 1973 engineering report indicated that at the current growth levels of that time, the withdrawals would drain the city's water supplies by 2020.

When water is withdrawn from Lake Holiday, the amount of water flowing out of the reservoir during late spring, summer, and early fall greatly decreases. During these periods, the only flows into the Obed River come from the water plant filter's backwash, groundwater supplies, limited flows from small tributary streams, and sewage treatment plant discharges.

Proposed Impoundments. A 100-acre (40.4 hectare) lake and 1.5 MGD water treatment plant have recently been proposed for construction on Clear Creek by the Catoosa Utility District and Farmers Home Administration. The site is at river mile (RM) 44, approximately 26 miles (41.8 kilometers) upstream of the Obed WSR, and will have a 5.89 square mile (1,525.5 hectares) watershed. Other similar projects may be proposed in the future as development pressures around the Crossville area increase.

Floodplain Information

Although general direction for the management and protection of floodplains can be found in Floodplain Management Guidelines (NPS 1993a), detailed floodplain information has not been developed for the major streams within the Obed WSR. This information would consist of computed flood flows and flood elevations and detailed floodplain mapping. Generally speaking, the floodplains of the major streams within the Obed WSR are largely undeveloped. Because of the steep stream slopes and narrow river valleys on these streams, the floodplains are relatively narrow. Flood damage would be primarily limited to county roads and bridges.

Wetlands

The NPS has a legislative mandate to preserve the resources of the National Park System, to facilitate public enjoyment of these resources, and to do both in ways that ensure their unimpaired integrity for use and enjoyment by future generations (NPS 1998). Executive Order 11990 directs the NPS to

avoid adverse impacts associated with the destruction or modification of wetlands and to avoid support of new construction in wetlands wherever there is a practicable alternative (NPS 1998). NPS actions that adversely impact wetlands require compliance with the USACE 404 permit procedures for activities that discharge dredged or fill material into waters of the U.S., including wetlands and Section 404 of the Federal Clean Water Act (NPS 1998).

Wetlands serve many functions in the Obed WSR. They include sediment retention, wildlife habitat, habitat and landscape diversity, and some amount of nutrient cycling and production export. Because of the small total number and overall acreage of wetlands in the Obed WSR and surrounding Cumberland mountain region, all of the wetlands in the Obed WSR boundaries should be considered to be functionally and ecologically important.

WA retained Barbara Rosensteel, JAYCOR, Inc. Environmental Wetlands Specialist, in August of 1996 to analyze National Wetland Inventory (NWI) maps and determine the presence and location of wetlands within the Obed WSR. Her findings are presented in Appendix D. The jurisdictional status of the mapped wetlands, the potential for the occurrence of additional wetlands, and a brief functional determination was included in the analysis. Wetland identification was based on vegetation, visible hydrology, and geography. Potential wetland areas were determined from topographic evidence and professional knowledge of upper perennial river systems.

The wetlands were classified according to the Cowardin system for the classification of deepwater habitats and wetlands (Cowardin et al. 1979). The wetlands mapped by the NWI in the Obed WSR include the following Cowardin system classifications:

- Riverine Upper Perennial Rock, Rubble, Permanently Flooded
- Riverine Upper Perennial Rock Shore, Rubble, Seasonally Flooded
- Palustrine Scrub-Shrub Broad-leaved Deciduous, Temporarily Flooded
- Palustrine Forested Broad-leaved Deciduous, Temporarily Flooded

The Upper Perennial subsystem of the Riverine System is characterized by High-gradient, high-velocity water flow. The substrate consists of rock, cobbles, or gravel with occasional patches of sand. The Rock Bottom class, Rubble subclass, and Rocky Shore class are all characterized by bottom areas with 75 percent or greater cover of stones, boulders, and bedrock; and vegetative cover of less than 30 percent. The vegetative cover consists of lichens, blue-green algae, mosses, and liverworts. The two Rivenne system wetlands would not be considered to be jurisdictional wetlands because of the absence of emergent vegetation.

The Palustrine System includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, and emergent mosses or lichens. The Palustrine Scrub-Shrub and Forested wetlands are dominated by woody vegetation less then one and greater then six meters tall, respectively. Dominant woody species in wetlands in this area are buttonbush, smooth alder, silky dogwood, red maple, green ash, and sycamore.

The Obed River, Clear Creek, and Daddys Creek in their entirety within the Obed WSR are classified as Riverine Upper Perennial Rock, Rubble, and Permanently Flooded wetlands. They are not considered to be jurisdictional wetlands because of the absence of vegetation. Four wetlands were located on the Obed River and 28 potential wetland areas may exist within the banks of the Obed River, Clear Creek, and Daddys Creek and at tributary confluences (Appendix D).

Certain types of Rivenne system wetlands may exist within the banks of the Obed River, Clear Creek, and Daddys Creek and at tributary confluences. These include:

- Riverine Upper Perennial Rocky Shore Bedrock
- Riverine Upper Perennial Rock Shore Bedrock
- Riverine Unconsolidated Shore Cobble Gravel
- Riverine Unconsolidated Shore Sand
- Riverine Unconsolidated Shore Vegetated
- Riverine Upper Perennial Streambed Bedrock

- Riverine Upper Perennial Streambed Rubble
- Riverine Upper Perennial Streambed Cobble-Gravel
- Riverine Upper Perennial Streambed Sand
- Riverine Upper Perennial Streambed Vegetated

In a region with a limited wetland resource, the scattered incremental loss of wetlands could rapidly escalate to a significant cumulative impact to wetland functions and dependent aquatic systems. Therefore, field investigations at the appropriate time of year are necessary to find wetlands that may have been missed in the NWI mapping and to verify the presence and extent of NWI-mapped wetlands. In this way, the impact of future development in the Obed River watershed on wetlands within the Obed WSR could more easily be identified and necessary actions taken to protect them.

Water Quality

Due to impacts such as organic enrichment, low DO, nutrients, siltation, and flow alterations resulting from municipal point sources, land development, and dam construction, the portion of the Obed River that flows through Crossville, Tennessee is designated as “partially supporting” of its designated uses (TDEC 1994). As the river course approaches the boundaries of the Obed WSR, the effects of dilution from tributaries improve the water quality of the Obed River to the extent that it is considered to be “fully supporting” by the time it reaches the National Park Service Unit’s boundaries.

Impacts upon the Obed WSR water quality come primarily from areas in the watershed that lie outside of Obed WSR boundaries (Rikard 1985). Therefore, water quality studies and monitoring should include areas in the watershed beyond the Obed River, Clear Creek, and Daddys Creek (Spradlin 1993).

The USGS NAWQA Unit began monitoring water quality, on a monthly basis, at Lilly Bridge on Clear Creek during the summer of 1996. Water quality parameters used by USGS include: temperature, pH, conductivity, and DO are determined in the field, iron, sulfate, manganese, turbidity, chloride, hardness, acidity, alkalinity, total and fecal coliform and fecal strep.

The Obed WSR National Park Service Unit has monitored water quality at ten stations within its boundaries since 1982 (Table 6). Fifteen parameters were selected to identify the water quality concerns relative to coal mining, oil and gas exploration, sewage discharge, garbage disposal, agriculture and forestry practices. Temperature, pH, conductivity, and dissolved oxygen are determined in the field. Iron, sulfate, manganese, turbidity, chloride, hardness, acidity, and alkalinity levels are determined at the Big South Fork National River and Recreation Area (Big South Fork NRRA) in-house laboratory. Total and fecal coliform and fecal strep are also determined. This work is conducted by ancillary staff support from Big South Fork NRRA. Additionally, TDEC began monitoring water quality at three stations within the Obed/Emory River watershed, (but outside the Obed WSR) in January of 1997 (Table 6) as part of a new program for watershed, water quality monitoring.

In January of 1997, the TDEC began conducting water quality sampling on the Obed/Emory watershed. This sampling will continue for a period of two years as part of a statewide, two year rotational, watershed sampling program (Stodola, TDEC, personal communication). The TDEC has selected three water quality, sampling stations for the Obed/Emory watershed (Cartwright, TDEC, personal communication). One of the stations is located at Potter Ford on the Obed River and is sampled bimonthly. Another station is located on the Emory River at Oakdale and is sampled bimonthly. The last station is an “ecoregion” station (i.e., considered to be typical for the ecoreg ion in terms of physiography, gradient, etc.) and is located on Clear Creek at Jett Bridge (State Highway 298). This station is sampled quarterly. TDEC has no plans for additional water quality monitoring stations (Stodola, TDEC, personal communication).

Seven NPDES permits designed to limit the amount and type of effluents discharged into Obed River watershed have been issued by the TDEC (Table 7). These permits are all

Table 6. Water Quality Monitoring Stations

Location of Water Quality Station	River/Creek Mile	Sampling Schedule
NPS Stations		
• Clear Creek at Lilly Bridge	1.5	Monthly
• Clear Creek at Barnett Bridge	8.7	Monthly
• Daddys Creek at Devil's Breakfast Table	2.4	Monthly
• Emory River at Nemo Bridge	27.7	Monthly
• Emory River above mouth of Obed River	29.0	Monthly
• Otter Creek at bridge crossing off of Catoosa Road	—3.2	Monthly
• Obed River at Potter Bridge (bacteria only)	13.0	Monthly
• Obed River just below Adam's Bridge	24.8	Monthly
• Mouth of Rock Creek above Nemo Bridge	0.0	Monthly
• Mouth of White Creek above Barnett Bridge	0.0	Monthly
TDEC Stations		
• Potter Ford on the Obed River	20.8	Bimonthly
• Emory River at Oakdale	18.3	Bimonthly
• Clear Creek at Jett Bridge (Highway 298) (Genesis Road)	—6.5	Quarterly

Table 7. NPDES permits issued in the Obed River Watershed.

Permit Number	Permit Issued To:	County	River / Creek
TN0060941	City of Crossville, Tennessee Water Treatment Plant	Cumberland	Obed River
TN0067822	Flowers Thrift Store	Cumberland	Obed River
TN0067831	Crab Orchard Utility District Water Treatment Plant	Cumberland	Otter Creek
TN0024996	Crossville, Tennessee Sewage Treatment Plant	Cumberland	Obed River
TN0025615	Fairfield Glade Sewage Treatment Plant	Cumberland	Daddys Creek
TN0027634	Tennessee Department of Transportation, 1-40 R.A. Cumberland	Cumberland	Daddys Creek
TN0073750	Plateau Ready Mix	Cumberland	Unnamed Branch to Obed River

related to municipal and industrial effluents (Smith, TDEC, personal communication).

The City of Crossville has two designated water quality monitoring stations and has no plans for any additional sites (Annis, Crossville Wastewater Treatment Facility, personal communication). The designated stations are located one and two miles below the city's sewage treatment plant (STP). With recent improvements in the aquatic communities (as documented by Wendel Pennington Associates, Inc.) and enlargement of plant facilities, the Plant's NPDES permit no longer requires instream biological and chemical testing at these stations unless an impact is

suspected (Annis, Crossville Wastewater Treatment Facility, personal communication; Stodola, TDEC, personal communication). However, the STP's NPDES permit does require water chemistry monitoring directly below the plant's discharge on a daily basis.

Historical water quality data for the Obed River watershed has shown that the primary impacts upon the Obed Wild and Scenic River and its tributaries have been from agricultural and/or forestry practices (i.e., plantations) in the area (Rikard 1985). A second, but possibly more severe impact, can be produced by acid mine drainage from coal mining in the watershed (Rikard 1985). Current data has shown that although the most significant impacts are still from agricultural and/or forestry practices, there is increasing influence from urban development in the upper reaches of the Obed River in and around the city of Crossville, TN (Wojtowicz and Clark 1989; TDEC 1994). It would appear prudent to continue monitoring agricultural and commercial forestry practices in the watershed due to the occurrence of Atrazine, a commercial pesticide, in trace amounts throughout the watershed (Treece, USGS, personal communication).

Obed River. On the Obed River proper, the primary impacts are from the city of Crossville, Tennessee and the surrounding area. Most of these impacts can be related to the increased levels of urban development taking place in this region. The source of particular interest in the past has been the Crossville STP. As mentioned, effluent from this plant is regularly tested for toxicity directly below the discharge point using standard methods (Eckenfelder 1991a, 1991b, 1991c). Results from these

tests showed some mortality of Ceriodaphnia dubia and some effects on the growth of fathead minnows. Earlier studies of the reach below the STP indicated that the river's condition was in an unhealthy state, but was comparable to the reach above the STP (Melgaard and McKinney 1979; Sulkin 1988). These studies indicated that although the STP was having a negative influence on the river the most significant impact was occurring upstream of the plant. Sources of impact responsible were considered to be urban runoff/erosion, the water plant backwash water, and low flow effects from Lake Holiday (Sulkin 1988). Results from later studies have indicated similar conditions still exist and are increasing due to more urban development (Wojtowicz and Clark 1989; Pennington and Assoc. 1994). Current state classifications show that the portion of the Obed River that flows through Crossville is designated as "partially supporting" of its designated uses due to organic enrichment, low DO, nutrients, siltation, and flow alteration, resulting from municipal point sources, land development, and dam construction (TDEC 1994). At the point where the Obed River flows into the National Park Service Unit boundaries, the effects of dilution from tributaries have improved the water quality to the point where the river is designated "fully supporting".

Clear Creek. Clear Creek has shown little evidence of impacts. Slightly elevated levels of conductivity, fecal coliform, and fecal streptococcus indicate some impacts from agricultural practices and potentially human waste disposal systems (septic systems, STP) (Rikard 1985; Spradlin 1993). Recent detection of the pesticide Atrazine, in trace amounts, indicates impacts from agriculture as well (Treece, USGS, personal communication). Trace levels of sulfates were also detected, which may indicate some minor runoff from coal mining activities (Rikard 1985). However, sulfates can also be produced by mere disturbance of certain minerals in the watershed (Julian, TVA, personal communication).

Other Tributaries. Of the many tributaries into the Obed Wild and Scenic River, four have been the subject of past and present monitoring. These are: White Creek (flows into Clear Creek), Daddys Creek and Otter Creek, (flow directly into the Obed River), the Emory River (the Obed River flows into it at the lower end of the Obed WSR boundaries), and Rock Creek which flows into the Emory River before it enters the Obed WSR boundaries (Rikard 1985; Spradlin 1993).

Both White Creek and Daddys Creek have experienced slightly elevated levels of conductivity and hardness, indicating some impacts from agricultural and/or forestry practices (Rikard 1985). More current data has shown that these conditions persist but have not worsened (Spradlin 1993). Otter Creek has experienced some degradation due

to the exposure of coal seams and the location, construction, and operation of Dartmoore Lake (Bakaletz, NPS, personal communication).

The Emory River has been designated as only "partially supporting" of the use classifications designated by TDEC through much of its course due to siltation resulting from surface mining and highway maintenance and runoff (TDEC 1996). These impacts are greatly reduced due to the effects of dilution downstream of the Obed River confluence.

One of the most heavily degraded tributaries in the system is Rock Creek. The effects of acid mine drainage have made this stream almost unsuitable for aquatic life (Rikard 1985). Recent data suggest that conditions have changed little (Spradlin 1993).

Groundwater Resources **Obed**

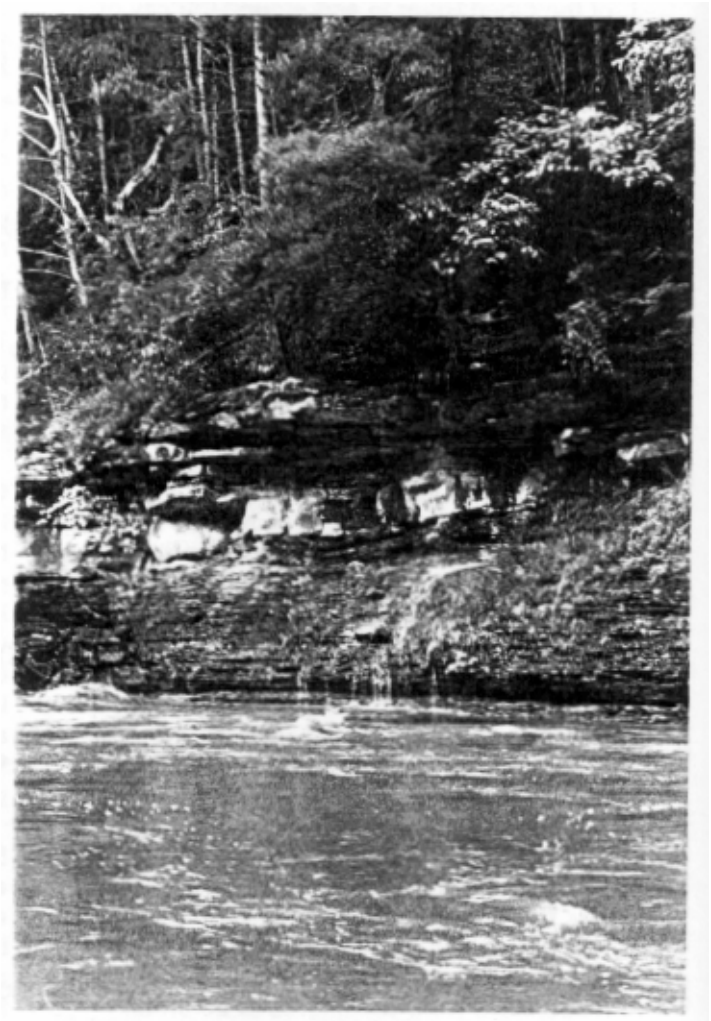
River Watershed

The Obed River watershed is located in the Cumberland Plateau physiographic province of Tennessee's Cumberland Plateau (note: for a detailed description of the area's physiography see the Physiography section). The watershed is drained by the Obed River and its tributaries (as shown in Figure 13). Areas southeast of the watershed boundary are drained by Piney Creek and the Sequatchie River which originates from the subsurface drainage of Grassy Cove (Figure 13). Fentress County, north of the watershed, is drained by the Obed and Wolf Rivers. The eastern portion of Fentress County is drained by tributaries to the New River which subsequently flows into the Cumberland River.

Hydrogeology

Geology. The Obed River watershed is immediately underlain by gently dipping Pennsylvanian sandstones, siltstones, shales, some conglomerates, and coals (Figure 14). These rocks have a thickness of about 1,500 feet (457.2 meters). The Pennington Formation of Mississippian age is a transition from the basal Pennsylvanian sandstone and shale to underlying Mississippian carbonate rocks that are less resistant to weathering. These carbonate rocks are predominately limestones, calcareous shales, and siltstones, with a maximum thickness of about 1,000 feet. The Devonian Chattanooga shale and Rockwood Formation of Silurian age underlie the Mississippian rocks.

Uppermost rock units of the Obed River watershed are depicted in Figure 15. The Rockcastle conglomerate dominates as the uppermost rock in the watershed although younger formations occupy isolated higher elevations on the plateau and along the southeastern border. As shown in Figure 15, the Obed River and major tributaries have incised through the Rockcastle conglomerate and underlying Vandever, Newton, and Whitwell Formations to the Pennington Formation. Mississippian limestones outcrop



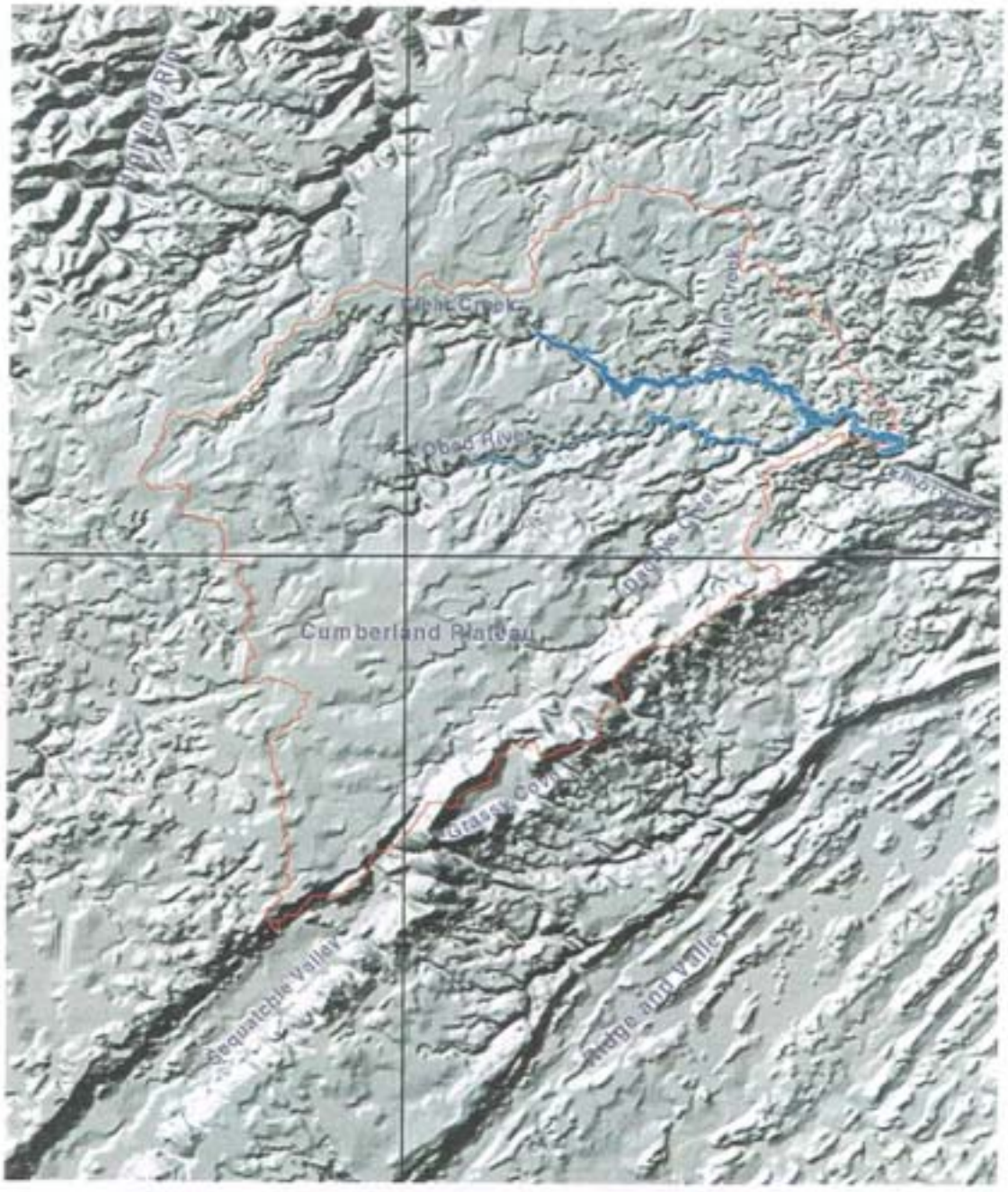


Figure 13. Digital elevation model of the Obed River Watershed and vicinity depicting major physiographic landforms.

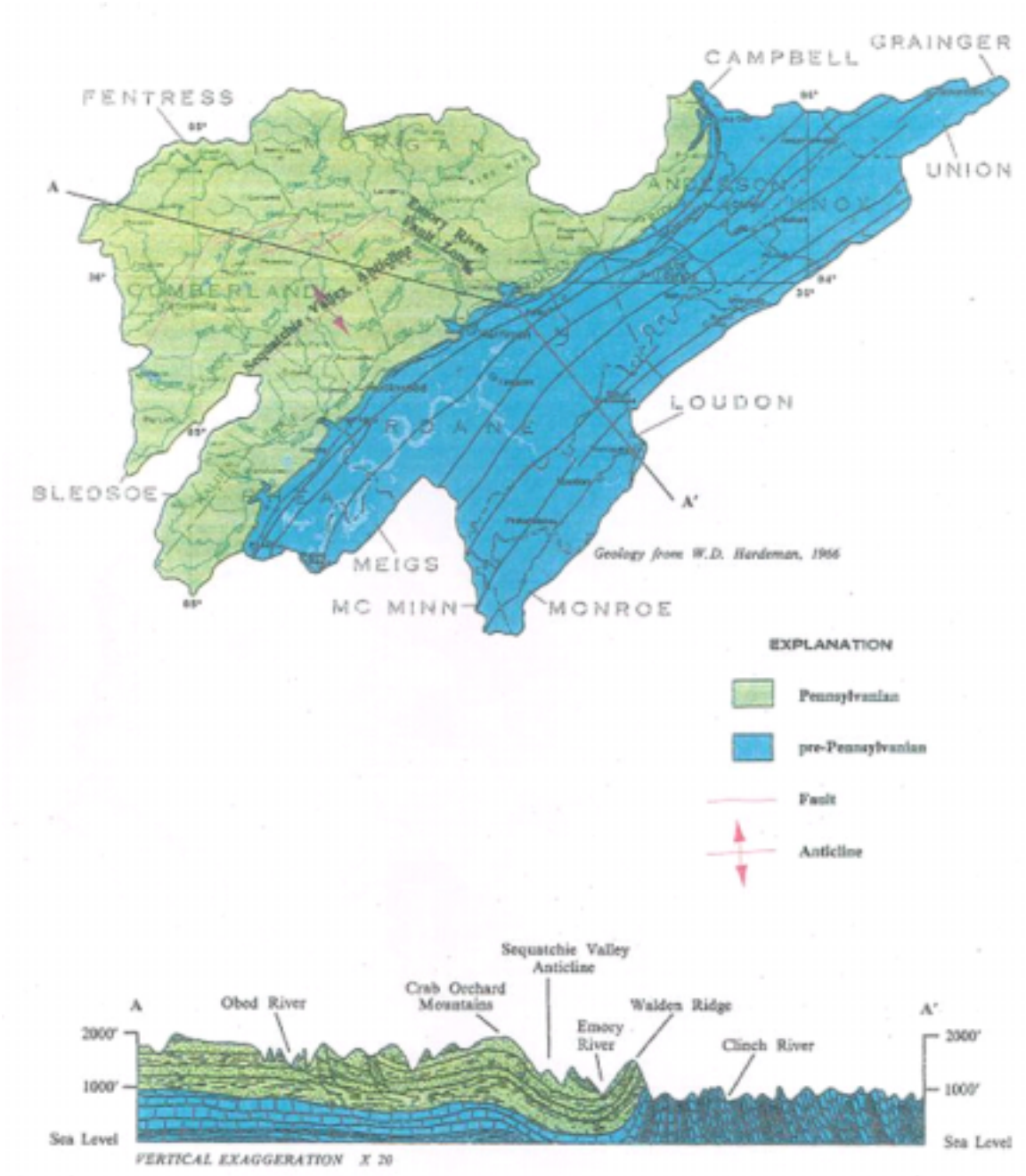


Figure 14. Generalized geologic map and cross section of the Obed River Watershed and vicinity (adapted from Gaydos et al. 1982).

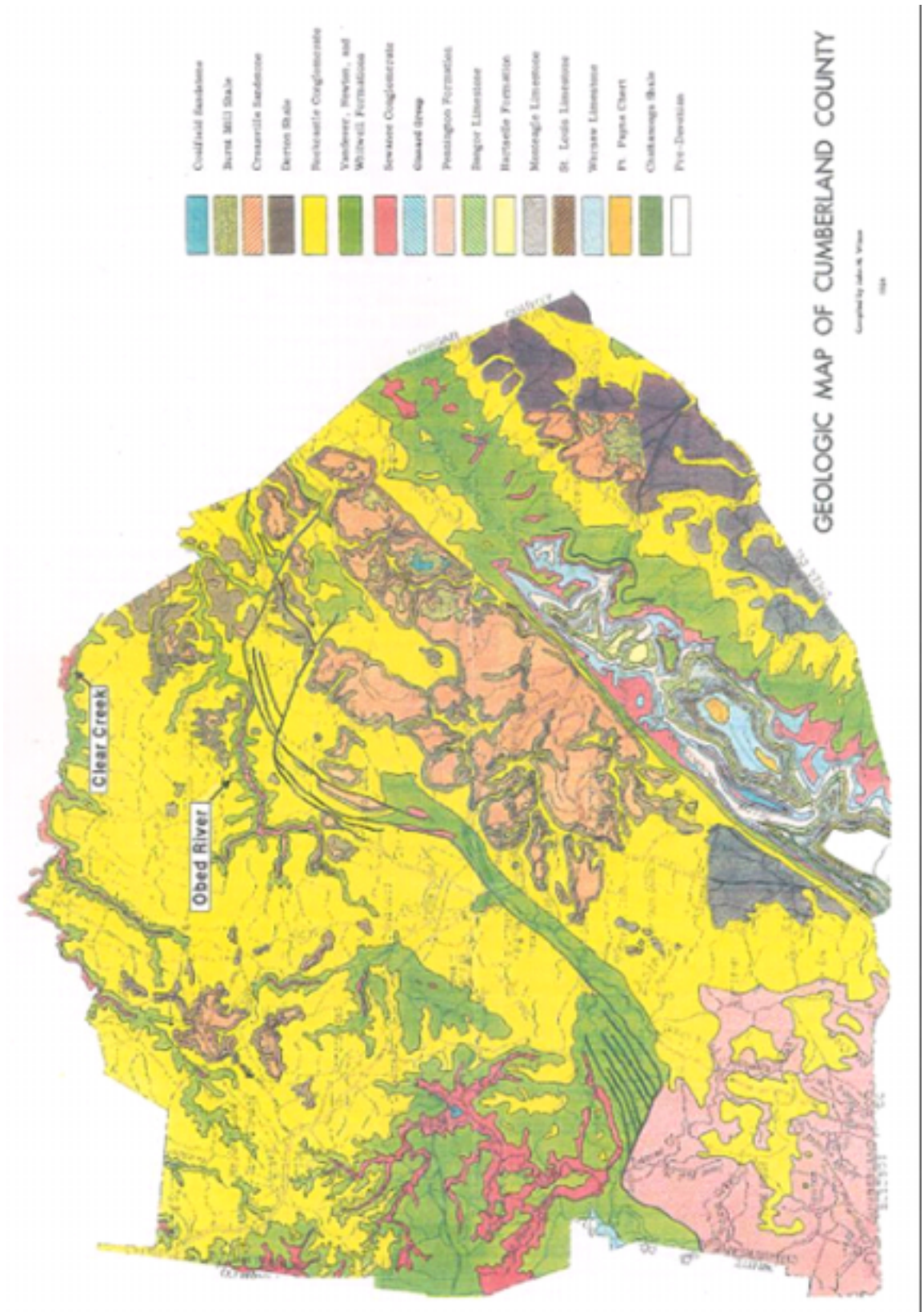


Figure 15. Geologic map of Cumberland County (adapted from Wilson 1965).

along the Sequatchie Valley escarpment, Grassy Cove, and smaller cove areas south-southeast of the watershed boundary.

The same mountain-building forces that resulted in the Southern Appalachian Mountains and deformed the rocks of the Valley and Ridge formed the structures of the Cumberland Plateau. Rocks along the eastern escarpment of the plateau and many miles westward along some zones were extensively faulted and folded (Figures 13 and 14). The structural trend is SW-NE like the Southern Appalachians. The Sequatchie Valley, one of the largest and most spectacular anticlinal valleys in the world, owes (in part) its origin to these forces. At the northeastern end of the anticline, massive sandstone forms the Crab Orchard Mountains. The anticline diminishes to the northeast and disappears at the Emory River Fault zone. This fault zone is part of a long belt of structural deformation northwest of the Crab Orchard Mountains. The belt is largely a series of thrust faults that are connected by cross faulting and anticlines (Swingle 1961).

Aquifers

The soil over most of the plateau is too thin to be of any regional significance as an aquifer, although soil thickness and permeability at specific locations can produce ample groundwater supplies for domestic purposes. Within the Obed WSR watershed, the primary aquifer system resides within shallow Pennsylvanian sandstones and conglomerates. However, certain Pennsylvanian rock formations are better aquifers than others due to their hydraulic characteristics and recharge attributes. Deeper aquifers also occur within the Obed WSR watershed in Pennsylvanian rocks and Mississippian limestones. However, their exploitation is limited by depth and hydraulic characteristics. Shallow aquifers that border the Obed WSR watershed or occur in isolated areas include karstic zones and colluvial/alluvial deposits at the base of the escarpment. These aquifers are not considered regionally extensive since they occur in isolated areas or along narrow horizons. However, they are important recharge considerations in an evaluation of water resources for the Obed WSR. In a generalized form, aquifers within the watershed area include:

- Shallow aquifers (< 200 feet) within Pennsylvanian sandstone and conglomerates
- Deeper aquifers (> 200 feet) within Pennsylvanian sandstone and conglomerates (and Mississippian rocks)
- Shallow karstic aquifers in cove areas along the Cumberland Plateau
- Shallow colluvium/alluvium and underlying karst aquifers at the base of the Cumberland Plateau escarpment

Recharge. Recharge is an important consideration in the potential development of groundwater supplies in the watershed area. In general, groundwater levels (storage) tend to follow a seasonal cycle (related to precipitation and evapotranspiration) with highest levels occurring in the spring and lowest levels in the late fall (Gaydos et al. 1982a, 1982b). Upland aquifers in the study area are recharged by precipitation and local inflow from losing streams. According to Hoos (1990), the recharge rate for the shallow and deeper sandstone/conglomerate aquifer of the Cumberland Plateau ranges from 4 to 9 in./yr. and averages 6.5 in./yr. Based upon hydrograph and regression analyses of stream flow data by Hoos (1990), the net annual recharge estimates for the Emory River (near Oakdale, Tennessee), the Obed River (near Lancing, Tennessee) and Daddys Creek (near Hebbertsburg, Tennessee) are as shown in Table 8.

Recharge to bordering karstic aquifers is highly variable due to direct recharge from upland streams and changes in groundwater flow paths (and subsequent storage) under different recharge rates.

Geographical Distribution of Existing Water Supply Wells. Julian (1996) evaluated the extent of shallow aquifer use using water supply well records of Cumberland and Fentress County obtained from the TDEC. Although this is the most comprehensive database known to exist for the area, it should be noted that it is not a complete record of all domestic and industrial wells in the study area. The database included 1,536 supply wells in Cumberland County and 664 wells in Fentress

Table 8. Net Annual Recharge Estimates for Cu Streamfiow Hydrograph and Regr mberland Plateau ession Analyses (Aquifers Based Upon Hoos 1990)

Station	Date	Flow Condition	Recharcie (in./yr.)
Emory River	1973	High	10.2
Emory River	1970	Average	8.9
Emory River	1969	Low	3.7
Obed River	*1975*		
Obed River	1983	Av	
Obed River	1981		
Daddys Creek	1962		
Daddys Creek	1968	Av	
Daddys Creek	1966		

County. The reported wells are dispersed primarily within the flatter areas of the study area along highways and secondary roads. The mountainous area in southeastern Cumberland County and the dissected NW corner of Fentress County exhibit significantly fewer wells due to natural geographic boundaries and lower population densities.

Shallow Aquifers within Pennsylvanian Sandstone and Conglomerates. For the purposes of this report, shallow wells are those limited to depths of 200 feet (61 meters). On the Cumberland Plateau, beds of sandstone and conglomerate are the main sources of water supplied to shallow wells. The soil over most of the plateau is too thin to be of any significance for groundwater supplies. Shale and coal beds act as confining layers. Because these rocks contain little primary porosity (intergranular voids), groundwater occurs mostly in secondary openings such as fractures and joints. Locally, groundwater exists under artesian pressure and perched aquifers are also common. Springs occur at natural discharge points from fractures, joints, and bedding planes in horizons underlain by low permeability rocks (Julian 1996).

Where present, the uppermost rock formation in Cumberland County, the Coalfield Sandstone, might provide minor groundwater storage and low yields to wells. The Crossville sandstone, where present, is probably the most shallow aquifer in the area although the formation is well indurated and not conducive to the abundant occurrence of groundwater except in vicinities of surface streams. The chemical quality of water from the Newton sandstone is characterized by moderate hardness, the presence of silica, low manganese, and significant iron concentrations. Yields of 5 to 10 gallons per minute (gpm) from this formation are not uncommon. In a study by Wilson (1965) on 153 shallow water supply wells in Cumberland County, 70 percent of the wells are completed in the Rockcastle conglomerate that underlies the Newton sandstone and Dorton shale. The water occurs in fracture systems of the massive crossbedded sandstone, which is the principal component of the formation, and along bedding planes separated by thin shale stringers. Water from the Rockcastle is characterized by a moderately low hardness, high iron and manganese concentrations, the presence of silica, and low pH. Virtually all water in the Rockcastle is under artesian pressure.

Table 9 provides statistical information for shallow wells in the study area for which information was available from TDEC. As shown in Table 8, there are little differences between well depth parameters; however, the average yield for Cumberland County wells appears slightly higher. This might simply be the result of the well population available for each county. Only 20 (1.3 percent) of the reported shallow wells in Cumberland County exceed yields of gpm and only 2 of the reported shallow wells in Fentress County

Table 9. Statistical Information for Shallow Wells in Fentress and Cumberland Counties.

Cumberland County (1251 wells)					Fentress County (611 wells)				
	Total Depth	Yield (gpm)	Producing Zone Depth (feet)	Static Water Level (feet)		Total Depth	Yield (gpm)	Producing Zone Depth (feet)	Static Water Level (feet)
Average	110200	88	463	1	140		65	82	5039	1
Minimum	75	35					5	3200	130	
Maximum							180	140100	4.5	
Median			193	150111	7		70	78		

exceed yields of 100 gpm. Based on the TDEC data, the most active water producing (high yield) zones average greater than 80 feet (24.4 meters) below ground surface and the vast majority of shallow wells are developed in the Rockcastle conglomerate. Figure 16 shows the shallow well yield distribution for Cumberland and Fentress Counties based upon the TDEC data. Wells with yields in excess of 50 gpm were not used to produce Figure 16. There were relatively few, and inclusion of the wells in the interpolated data set would have resulted in unrealistic results. The figure is merely an attempt to illustrate yields based on a limited database that suggests controls by geography and infrastructure.

Within a multi-county area in Kentucky and Tennessee that includes Cumberland and Fentress Counties (Gaydos et al., 1982a, 1 982b) the middle 75 percent of wells, when sorted by value of specific capacity, produce 2 to 44 gpm, assuming 50 feet (15.2 meters) of available drawdown. These records are part of a database of more than 900 wells in the area. Most of these wells were drilled to supply domestic or farm needs and typically produce water from depths of less than 150 feet (45.7 meters) below ground surface.

Shallow groundwater supplies from wells near perennial streams generally produce higher yields than distal wells. However, these wells are more likely to be influenced by surface water-borne contaminants since the adjacent streams might be providing immediate recharge to the aquifer. Groundwater supplies
that exceed 100 gpm have been developed for municipal water systems from wells drilled within a few hundred feet of perennial streams.

In 1952, Plateau Utility District (Wartburg, Morgan County) pumped two wells adjacent to a tributary of Crooked Fork Creek at 136 gpm each for 24 hr with less than 22 feet (6.7 meters) of drawdown (Hollyday et al. 1985). In 1994, Oneida Water and Wastewater Department (Scott County) reported withdrawals of 450 gpm from a well about 800 feet NW of Pine Creek (Mattraw 1996).

Compared to wells located in broad areas of low relief, wells adjacent to relatively higher terrain might produce higher yields if they intersect adequate producing zones. A supply well for the Westel Community in extreme SE Cumberland County has exhibited yields in excess of 100 gpm with drawdown of less than 0.1 feet (Wilson 1962). The well is completed to a depth of 99 feet in sand of the Rockcastle conglomerate. Depending on location, similar well yields can be obtained within the Obed WSR watershed.

Deeper Aquifers within Pennsylvanian Sandstone and Conglomerates. According to Wilson (1965), no local wells were reported to have been completed in the Vandever, Newton, and Whitwell Formations which underlie the Rockcastle conglomerate. This is primarily due to low permeability and poor water quality associated with coal seams and pyritic shales that reside within the formations. The Sewanee conglomerate underlying these formations, like the Rockcastle, is

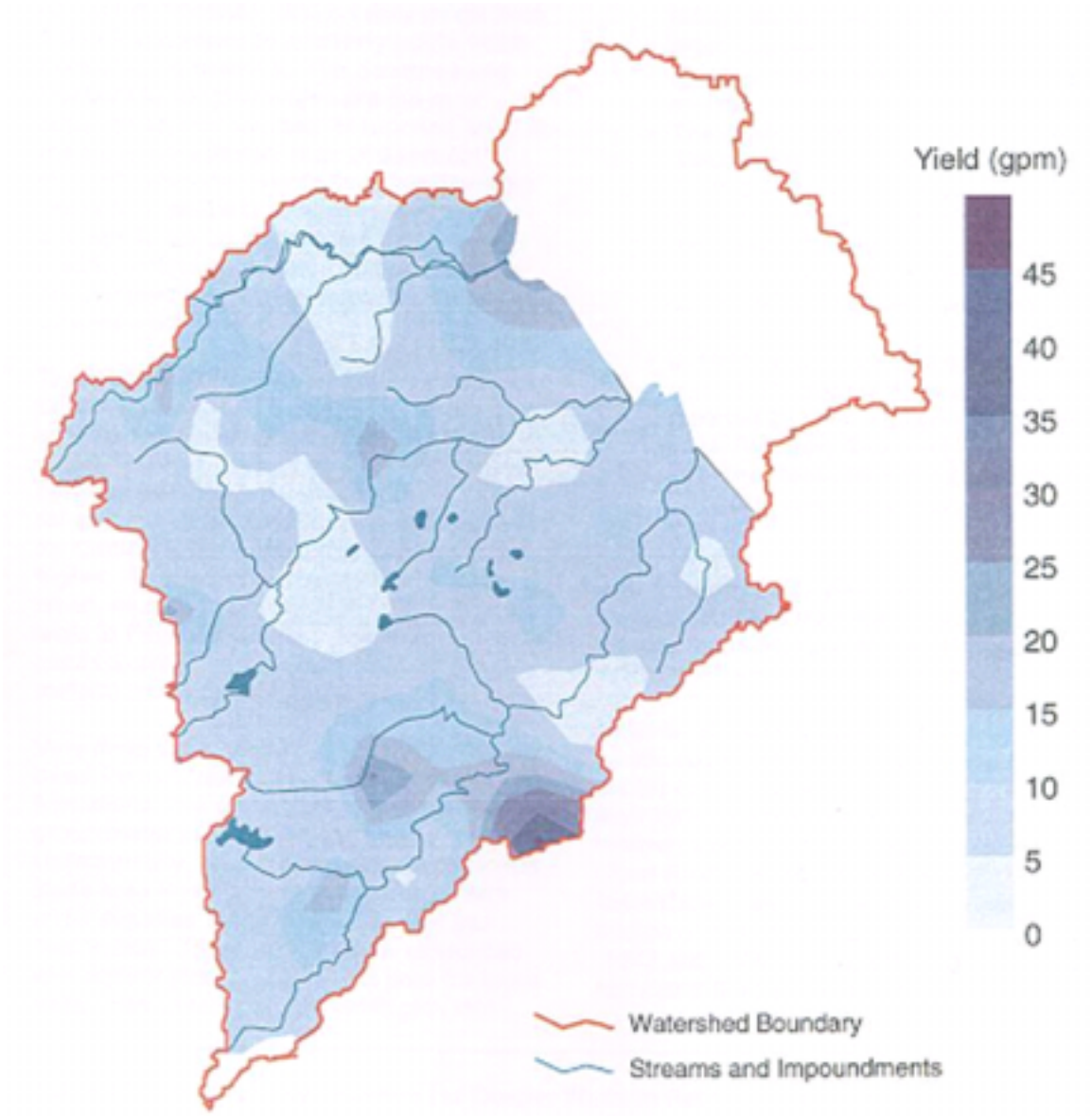


Figure 16. Shallow well (<200 feet deep) yields in Cumberland and Fentress Counties (from Julian 1996).

characterized by its massive structure and the occurrence of groundwater in fracture systems and along lenticular partings. Water from the Sewanee conglomerate is moderately hard. Its iron content is comparatively low, silica content is moderate, and pH may range from 5.5 to 9 in contrast to relatively acidic water from other formations. The Sewanee and Rockcastle conglomerates are the most common aquifer sources for reported wells in the study area deeper than 200 feet (61 meters). Reported yields from the Sewanee range from seeps to> 30 gpm, and the average is 5.5 gpm according to Wilson (1965). Artesian conditions are generally encountered for wells developed in the Sewanee conglomerate.

Table 10 provides statistical information for deeper wells in the study area for which information was available from TDEC. As shown in Table 9, there are little differences between well depth parameters (as is the case for shallow wells); however, the average yield for Cumberland County wells appears much higher. This might be the result of a relatively small, recorded population (67 total) of deep wells in Fentress County. The water producing zones average greater than 160 feet (48.8 meters) below ground surface.

Very deep wells, those extending into the basal Pennsylvanian and Mississippian formations, can produce significant amounts of groundwater in some circumstances. Unfortunately, drilling at greater depths in the study area is not generally associated with water supplies, but with coal, oil, and gas exploration. Therefore, the data associated with aquifer yield and quality is poor for these wells. However, Mattraw (1996) provides examples of oil and gas exploration wells for which groundwater data was collected:

- In 1984, the Hickman-Schirmer#1 Wildcat oil and gas exploration well 4.3 miles west of Lancing, Morgan County produced 500 gpm from a fracture in sandstone at a depth of 515 feet (157 meters).
- The Clyde Friels well located along Black Wolfe Creek, north of Glen mary, Scott County, was reported to produce such large quantities of water from depths of 400, 450, and 800 feet (121 .9,137.2, and 243.8 meters) that two combined drill rigs were required to advance the hole.
- In 1978, a diamond drill hole CC-20 north of Rockwood, Roane County, was reported by GRC Exploration to have an initial flow from 235 feet (71.6 meters) from the Rockcastle conglomerate of 570 gpm, eventually declining to 230 gpm.

These types of well yields are a hindrance to coal, oil, and gas operators. The high yields are also unusual, sporadic, and unpredictable without well records or exploratory drilling.

Shallow Karstic Aquifers. Several important karstic cove areas reside on the southeast border of the watershed boundary. Although their hydrogeologic significance is not directly related to water resource evaluations of the Obed River watershed, recharge of these subsurface systems should be an integral portion of watershed assessments. Crawford (1987 and 1989) among others, has conducted numerous field investigations within these

Table 10. Statistical Information for Deeper Wells in Fentress and Cumberland Counties.

	Cumberland County (279 wells)				Fentress County (67 wells)			
	Total Water Depth (gpm)	Yield Depth Level (feet)	Producing Zone Depth (feet)	Static Zone (feet)	Total Water Depth (gpm)	Yield Depth Level (feet)	Producing Zone Depth (feet)	Static Zone (feet)
Average	284	17	273	2				
Minimum	1	15						
Maximum	7 577	395	450	258	3520	500	25	320
Median	260	5	166	65	240	250	2	195
	164	81	202		182	131	205	1
							150	

areas to identify major subsurface drainage routes and to determine relationships between stream invasion and geomorphologic evolution. Noteworthy areas include: Grassy Cove, Crab Orchard Cove, Swaggerty Cove, Little Cove, and Bat Town Cove.

The USGS postulates that conditions along the base of eastern and western Cumberland Plateau escarpments might provide groundwater availability in shallow colluvium/alluvium and underlying karst aquifers (Mattraw 1996). This is based primarily on an investigation of the groundwater resources of the Valley and Ridge province from New York State to Central Alabama, called the Appalachian Valleys - Piedmont Regional Aquifer System Analysis (AP/RASA) project.

Groundwater Quality. The quality of groundwater in the watershed depends on several variables such as, composition of the aquifer, distance from recharge areas, length of time that water has been in contact with the aquifer, and the pattern of groundwater circulation. The quality of groundwater from the Pennsylvanian rock aquifers is quite variable, but is generally satisfactory for most purposes or can be made so with minor treatment. Typically the water is moderately mineralized, slightly acidic, and soft to moderately hard. Most wells and springs in this area exhibit iron concentrations in excess of the recommended limit.

The quality of groundwater from the Mississippian rock aquifers is generally good. Characteristically, the water is a calcium bicarbonate type and slightly alkaline. In some areas, hardness may be a problem and iron and chloride concentrations may exceed the recommended limits. There are reports of hydrogen sulfide gas in the water from some wells in the area.

Iron and chloride are the two most objectionable constituents in the watershed area. High iron concentrations are most likely to occur where water drains through beds of shale or coal. Chloride concentrations generally increase with depth where groundwater circulation and discharge are minimized; however, high chloride concentrations are known to occur at depths of less than 300 feet (91.4 meters) in some areas. Water from wells drilled into the water table is usually softer and less mineralized than water from greater depths in the bedrock aquifer.

The watershed resides in areas 17 and 19 of the Eastern Coal province and mining can adversely affect groundwater quality. Strip-mining is a common method for accessing coal in this area. These effects are most apparent at or near the mine site and problems generally diminish downgradientldownstream due to natural processes such as dilution. Additional mining activity downgradient/downstream can have a cumulative impact. Oil and gas fields and associated production wells can also impact groundwater in the study area. The influences of mining in the watershed are discussed in the Coal Mining section of the Land Status chapter.

Groundwater Supply Potential. Relatively abundant information exists in USGS and State files regarding the location, yield, and construction of domestic wells that are completed in the sandstone and conglomerates of the Cumberland Plateau. Data on yields of groundwater from wells situated near perennial streams in the Cumberland Plateau is restricted to a few documented cases, one of which is supported by water quality data. A base-flow reconnaissance of the streams in the area is likely to reveal the interconnection between the streams and the aquifers. Data from Wartburg and six other sites in Middle Tennessee support this later conclusion (Mattraw 1996). A large amount of data for deeper wells on the Cumberland Plateau **exists in the oil and gas files of the Tennessee** Division of Geology. However, these records were not collected with the intent of producing potable water and are difficult to interpret in this regard. Few records exist for wells and springs that serve as water supplies in karstic coves and along the Cumberland escarpment. Data is non-existent for wells drilled to withdraw water from the shallow colluvium/alluvium and underlying karst rocks at the base of the Cumberland Plateau escarpment.

Shallow Aquifers Within Pennsylvanian Sandstone And Conglomerates - Shallow well installation as an alternative water supply

supplement offers the advantage of geographic convenience but limited yield. It is likely that numerous wells (a well field) would be required and a well head protection area established in the watershed of choice. Depending on the volume of water required to complement the existing demand, the well field might extend over a large area. Assuming an aquifer recharge rate of 10 percent, the long-term sustainable yield for a shallow well field is estimated to be approximately 0.12 MGD/mi^2. Table 11 provides an approximated comparison of well field size and quantity of wells to satisfy various demands base upon the estimated average shallow aquifer conditions from Table 9.

Table 11. Shallow Well Field Requirements Versus Demand.

Demand (MGD)	Area Required Nu (mi^2)	mber Of Shallow Wells
0.1	0.8	6
0.5	4.2	32
1.0	8.3	63
2.0	16.7	127
3.0	25.0	190
4.0	33.3	253
5.0	**41.7**	**316**

As was previously mentioned, a well or wells adjacent to a perennial stream could provide substantially larger quantities of water depending on the low flow of the stream. This quantity could approach the mean annual low flow of the stream provided there is sufficient storage in the aquifer to supply the well(s) during low stream flow periods. Base-flow stream surveys and correlation of flow characteristics with gaged sites would be necessary to locate a suitable site for wells to satisfy water demands. Withdrawing a large percentage of the flow of the stream over the long term could be expected to have a significant impact on stream ecology. Additionally, wells located beside perennial streams are more likely to be influenced by surface water-borne contaminants and coal mining activities in certain areas. Hence, monitoring and treatment costs should be considered in evaluation of this alternative.

Deeper Aquifers (>200 feet or 61 meters) Within Pennsylvanian And Mississippian Rocks—As shown in Table 9, wells drilled to depth of greater than 200 feet (61 meters) do not supply significantly greater yields. The average yield in Cumberland County increases from only 11 to 17 gpm. In terms of feasibility, no significant improvement might be obtained for well fields installed to depths exceeding 200 feet except in very specific locations. However, high yields (> 0.5 MGD) have been observed at select well locations. Singular or groups of carefully located wells might be considered a viable water supply alternative. It is likely that these wells would be located near streams, in low areas with adjacent high topography, and/or in areas subject to much structural jointing/faulting. Unfortunately, few such wells have been documented on the flatter areas of the Cumberland Plateau.

Shallow Karstic Aquifers In Cove *Areas Along The Cumberland Plateau—While* abundant shallow groundwater supplies might exist in karstic cove areas, there are several important considerations in assessing this alternative. Although large quantities of groundwater might be obtained from a few selected well locations, the subsurface flow routes in this domain are along privileged routes and some amount of geophysical prospecting might be required for well drilling. Recharge to this system is direct and storage in the aquifer is transient; therefore, periods of low production might be anticipated. Since groundwater velocities are generally rapid and many surface openings provide recharge or allow potential contaminants to enter the groundwater system, continuous monitoring and potential treatment should be considered. Finally, depletion of groundwater from the karstic aquifer system may adversely affect biota habitats of caves and karst features of the area.

Shallow Colluvium/Alluvium And Underlying Karst Aquifers—According to Mattraw (1996), **a group of carefully located and properly** constructed wells at the base of Cumberland Plateau escarpment is considered a viable alternative for supply groundwater to the study area. It is likely that such a well field would be located adjacent to a stream. The saturated colluvium, alluvium, residuum, and karstic bedrock could provide the storage needed to satisfy withdrawals at the well field during periods of low or no stream flow. For such a

system, transient recharge effects might be diminished and some amount of protection from contamination might be afforded by the overburden. However, the costs of pumping and transmission remain an issue for feasibility analysis since these groundwater sources reside at the base of escarpment.

Aquatic and Riparian Resources and Habitats

Introduction

Water is the principal resource of the Obed WSR (NPS 1995). The quantity and quality of water supports one of the best assemblages of aquatic and nparian resources in the state. These resources include a wide variety of flora and fauna, as well as habitats necessary to maintain them. These resources are not limited to the Obed WSR National Park Service Unit. Obed WSR lands provide important habitat areas within the larger geographic area.

These assemblages are unique within the larger geographic area, one area has been identified by the USFWS as a critical habitat. The Obed also contains several state and federally listed endangered, threatened, and rare species (Appendix B). Protection of these ecosystems is important not only for their preservation but also as unique opportunities for research and public benefits such as observation, education, and recreation.

Flora

The Obed WSR has a substantial diversity of vegetation due primarily to the variety of habitats within the gorges. They range from the extremely dry conditions of rock outcrops to moist areas prone to frequent flooding along river gravel bars. Human activities on the plateau have also altered the composition of many plant communities. Surveys conducted by the TDEC and University of Tennessee (UT) have identified at least 734 taxa (NPS 1995). The TDEC and UT surveys have also identified seven plant communities. These communities include: Aquatic, Riparian, Floodplain Forest, Other Forests, Boulder Fields, Outcroppings, and Rock Cliffs. Schmalzer and DeSelm (1982) identified, what they believed to be, eight critical plant habitats within the Wild and Scenic River corridor.

Two of these habitats are associated with the nparian zone occurring on gravel bars: the lower Obed River gravel bar habitat and the Clear Creek-Lilly Bridge area gravel bar habitat. The Obed River gravel bar habitat is located on the Obed River between the junction of Daddys Creek and the Obed River and the Emory River. With the exception of sneeze-weed (Helenium brevifolium), all rare plants occurring in this habitat (i.e., roughleaf serviceberry (Amelanchier sanguinea), sandreed grass (Calamovilfa arcuata), Cumberland rosemary (Conradina verticillata), fetterbush (Leucothoe racemosa), Barbara buttons (Marshallia grandiflora), jointweed (Polyponella americana), and drop-seed (Spporobolus lunceus) are found in this stretch of gravel bar-sand bar habitat (Schmalzer 1982). Roughleaf serviceberry and drop-seed are known only from within this area in the Obed River system. Schmalzer (1982) indicated that because of this area's "high biological value," it should be recognized in planning and development. Schmalzer (1982) also indicated that fine examples of this habitat include: generally, the area from the junction of Little Clear Creek and Clear Creek to the junction of Clear Creek and the Obed River, and the gravel bars in the Lilly Bridge area. Many of the rare plants associated with this habitat, including Cumberland rosemary fetterbush and Barbara buttons, occur in this stretch of gravel bar habitat. Sneeze-weed is known only from this site within the Obed WSR (Schmalzer 1982).

No Obed WSR Tennessee have been federally listed as "Critical Habitat" for plant species (Collins, TVA, personal communication). The federal government considers "Critical Habitat" to contain significant populations of a rare species or provide habitat critical for their survival. Twenty-four plant species, with either federal or state status, have been identified within the Obed WSR according to TVA's Heritage Program database (Appendix B). Typical flora, as well as some usually restricted to other geographical locations, can be found in the Obed WSR. According to the GMP (1995), several species of azalea, rhododendron, and mountain laurel thrive in the watershed; blueberries grow in the open fields; and royal ferns line the banks of

streams. Sweetshrub is abundant, as well as partridge berry, ferns and an array of wild flowers. Stream-bank corridors are 90 percent forested with upland hardwood stands intermixed with pine and hemlock species (NPS 1993b).

According to Braun (1950), the area lies in the Deciduous Forest Formation and the Mixed Mesophytic Forest Region. It is characterized by mixed oak, oak-hickory and oak-pine communities. Schmalzer (1982) also recognized three major forest types in the area. A dry oak forest covers the upper slopes while the lower slopes are predominately a mesic mixed oak forest. A river birch community is located in the floodplains and represents the third forest type.

Because the ravines have been relatively inaccessible to logging, isolated pockets of relic virgin forest can be found scattered among stands of second growth trees. Evergreen species occurring in the Obed River watershed include hemlocks and white pines. Among the deciduous trees are many species of oaks, beeches, gums, maples, and magnolias.

Submerged and emergent aquatic vegetation can be found in pools and riffle of the Obed River and its tributaries. However, most of the rocky, river channel is not occupied by vascular plants (Schmalzer 1982). Yellow pond lily (Nuphar luteum spp.rnacrophvllum) occurs in pools and slow-flowing stretches of the river rooted in sandy substrate; it usually occurs in patches of several plants. Water willow (Justicia americana) roots in the gravely substrate in shallow riffles and near the edge of the stream. Its stems are emergent and it occurs in patches or colonies of several to many plants. Golden club (Orontium aciuaticum) occurs along the stream banks or in shallow riffles along or with water willow. Common river weed (Podostemum ceratophyllum), a submerged aquatic, occurs on rocks in rapidly flowing sections of stream.

Riparian shrub/herb communities inhabit gravel and sand bars adjacent to the streams. Schmalzer (1982) found riparian shrub/herb communities along the lower sections of Clear Creek, Daddys Creek, and the Obed River on gravel bars, sand bars, and boulder-stream areas within the annual flooding regime of the river. Seven species of shrubs and herbs are listed by the State of Tennessee as Threatened or Endangered (Appendix B). These shrub-thickets and perennial grasses depend upon periodic flooding. Most gravel bar habitats are in good condition, remaining relatively unimpacted from human activity.

Fauna

As with vegetation, the Obed WSR supports a diverse body of wildlife species. In 1982, Dr. Tom M. Abbott with Tennessee Technological University conducted a biological inventory and assessment of benthic macroinvertebrates, fish, and amphibian communities in an attempt to identify the effects of coal and oil mining activities and sewage effluents on the aquatic fauna. Results of this study indicated that Clear Creek had the most diverse biological communities with fourteen species of fish while the Daddys Creek had the most diverse benthic macroinvertebrate community (45 taxa identified to the genus level) (Abbott 1982b).

The most recent fish and benthic macroinvertebrate data for the Obed WSR was collected by TVA's Watts Bar, Fort Loudoun, Melton Hill River Action Team in cooperation with the USGS. The agencies' 1996 collections included 28 species of native fish (Appendix E). Some of the common species found to occur in a majority of the streams include: central stonerollers (CamDostoma anomalum), shiners, redbreast sunfish (Lepomis auritus), smallmouth (Micropterus dolomieu) and rock bass(Ambloplite rupestris), longear sunfish, (Lepomis megalotis) and river chub (Nocomis micropocion). The Obed River and Daddys Creek are also habitat for the one of the southern most populations of muskellunge or "Musky" (Esox maspuinongy) in the U.S. (Mayr, TWRA, personal communication). Qualitative benthic samples were collected by the team in 1996 at four stations: Norris Ford (Clear Creek Mile 14.8), Waltham Ford (Clear Creek Mile 8.7), Devil's Breakfast Table (Daddys Creek Mile 2.4), and Potter Ford (Obed RM 20.8). Benthic taxa were identified to the genus level. Taxa numbers ranged from 41 genera at Waltham Ford on Clear Creek (CCM 8.7) to 26 at Norris Ford (Appendix F).

Many species of wildlife are known to occur within the boundaries of the Obed WSR. However, relatively few vertebrate studies have been undertaken in the Obed WSR gorges. A terrestrial vertebrate inventory, conducted by Taylor et al., 1981, identified 31 mammal species, 75 reptiles and amphibians, 81 species of birds. The number of bird species was considered to be low at the time, when compared to other regions of East Tennessee. This was attributed to the fact that the habitat of the river gorge is restricted primarily to mixed deciduous forest, oak forest, and oak-pine forest. Only a few birds of open and brushy habitats were encountered. No standing bodies of water such as ponds and lakes exist in the gorge. Therefore, wood ducks **(**Aix sponsa), which utilize woodland streams, were the only waterfowl represented. These numbers were recently updated in the GMP for the Obed WSR (1995). According to the GMP (1995), 41 mammal and 138 bird species have been documented.

Common game species include white-tailed deer (Odocoileus virainianus), both gray (Urocyon cinereoargenteu!) and red fox (Vulpes fulva), gray squirrel (Sciurus caroliniensis), raccoon (Procyon lotor) cottontail rabbit (citrus unshiu), wood duck, mallard (Anas platyrhynchos) and turkey (Meleagris aalloøavo). Non-game species frequently seen are skunks, numerous songbirds, and raptors (NPS 1995).

Rare, Threatened and Endangered (RTE) Species

The NPS is especially concerned with protecting any rare, threatened or endangered species. For this reason, a number of biological surveys have been conducted within the boundaries of the Obed WSR since its establishment in 1976. A variety of rare flora and fauna were identified during these surveys.

Four federally-listed Endangered or Threatened plant species may occur in the Obed WSR: Cumberland sandwort (Arenaria cumberlandensis), Cumberland rosemary, American chaffseed (Schwalbea americana), and Virginia spiraea (Spiraea virginiana). Twenty-one plant species are state listed as either Endangered or Threatened, and three have "Special Concern" status (Appendix B).

Invertebrates in the Obed WSR with either federal or state status include the Alabama pearly mussel. It is the only species having federal endangered status. The Purple bean pearly mussel (Villosa perpurpurea) is listed as "Endangered" by both the federal government and the State of Tennessee (Appendix B). This mussel was collected by Steven A. Ahlstedt, a biologist with the U.S. Geological Survey (USGS) in July 1996. Three live and two "fresh dead" specimens were found at Potters Ford (Obed River Mile 20.8).

Vertebrates with federal or state status include: Helibender (Crvptobranchus alleganiensis), Ashy darter (Etheostoma cinereum), Spotfin chub (Cvønnella monacha), Tangerine darter (Percina aurantiaca), Longhead darter (Percina macrocephala), Red-cockaded woodpecker (Picoides borealis), and Eastern woodra Eastern big-eared bat (Corynorhinus rafinespuil), Black Mountain salamander (Desmoanathus welteri), River otter (Lutra canadensis), Allegheny woodrat (Neotoma magister), Eastern slender glass lizard (Ophisaurus attenuatus), and Smokey shrew (Sorex fumeus) (Appendix B). All portions of the Emory and Obed Rivers and Clear and Daddys Creeks within the Obed WSR are designated by the USFWS as "Critical Habitat" for the Spotfin chub (Peiren, USFWS, personal communication).

Exotics

The wild hog (sus sp.) was stocked on the Catoosa Wildlife Management Area in the past. A self-sustaining population of wild hogs is hunted on an annual basis in TWRA's Catoosa Wildlife Management Area. Feral hogs **(Sus** scrofa) are also known to occur in the area. Both wild and feral hogs cause erosion and can damage endangered plants and their habitats. Rainbow trout (Oncorhvnchus mykiss) and redeye bass (Micropterus coosae) have been introduced to the Obed WSR watershed but are no longer stocked by TWRA. Any brown or rainbow trout collected have most likely been introduced by fishermen (Herd, TWRA, personal communication). Rainbow trout are

known to compete with native fish species for food.

Non-consumptive Water Uses

Recreation

According to NPS's most recent Internet information on visitation, recreational visits to the Obed WSR far out number those non-recreational visits. In 1993, 226,100 visits to the Obed WSR were oriented toward recreation, whereas only 10,800 were non-recreational. This pattern was also evident when recreational hours (948,900 hours) were compared to non-recreational hours (900 hours), and recreational days (79,100) were compared to non-recreational days (100).

An array of recreational opportunities is available within the boundaries of the Obed WSR. Being relatively uninhabited, with limited road access, the Obed WSR provides an excellent small-scale wilderness opportunity. The variable terrain and abundant relatively unpolluted water supply of this primitive area create beautiful vistas for sightseeing as well as opportunities for whitewater boating, hiking, camping, rock climbing, hunting, fishing, picnicking, and swimming.

Whitewater Boating. Whitewater paddling is one of the more popular recreational sports in the Obed WSR. Canoeing and kayaking bring many people to the Obed WSR that offers one of the best and most difficult whitewater regions in the eastern U.S.. The Obed/Emory watershed offers 142 miles (228.5 kilometers) of canoeable whitewater streams, ranging in difficulty from Class I to the highly technical Class V (Smith 1980). The headwaters of the abed/Emory watershed are atop the Cumberland Plateau in Tennessee, between Knoxville and Nashville. This factor accounts for the remarkable whitewater characteristics and other scenic attributes of the Obed River watershed.

The cold rainy season between December and April is typically the time the rivers are full enough for float trips. At that time, the streams can have nearly continuous rapids and dangerous currents and can technically be considered whitewater. Some of the popular whitewater areas include: Daddys Creek Canyon, Obed River from Devil's Breakfast Table to Nemo, Clear Creek from Jett Bridge to Nemo Bridge, Obed River at Gould's bend, Obed River from Adams Bridge to Obed Junction, Clear Creek from US 127 to Waltman Ford Bridge, Daddys Creek from the center to Antioch, (Upper) Daddys Creek from Sutton Dam to Highway 68, Clear Creek from Waltman to Jell, and Daddys Creek from US 70 to Center Bridge (Smith 1980).

Hiking. Hiking trails are being planned, but it may be some time before they are available for use. The proposed system of linear and looped trails would provide approximately 30 miles (48.3 kilometers) of hiking opportunities (NPS 1995). A number of logging roads in the Catoosa Wildlife Management Area are no longer open to traffic and can now be used for hiking.

Camping. Rock Creek campground (a primitive campground) is located at Norris Bottoms. Six campsites are currently available on a first come basis. ATV's and horses are allowed in the campground. However, ATV's must remain on graveled areas and horses must be kept at campsites with hitching posts. Another primitive campground and picnic area is located at Nemo Bridge.

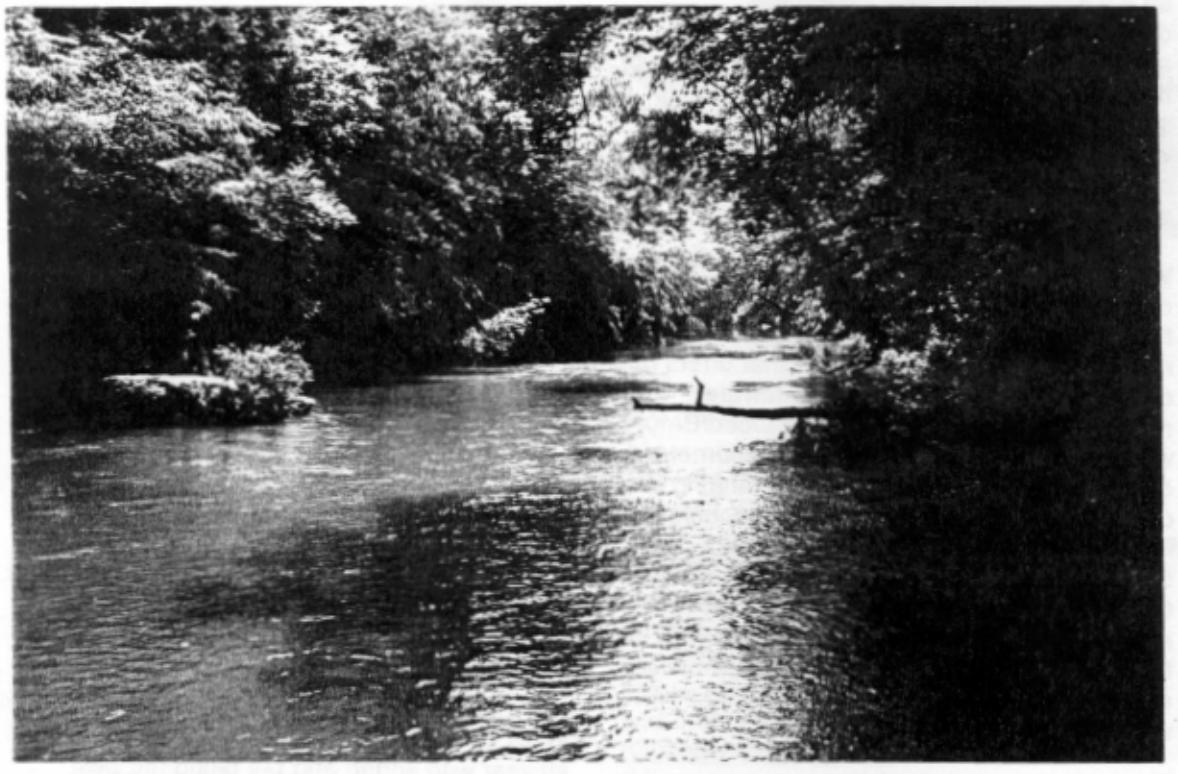
Rock Climbing. Rock climbing in the Obed River area is an exceptional experience due to the superb quality of the sandstone cliffs in a remote wilderness setting. Access to all of the major areas is easy with the longest approach being two miles. There are three primary climbing areas: the Obed, North Clear Creek, and South Clear Creek. There is a mixture of both traditional and sport routes, ranging in grade from 5.7 to 5.13. There is only one small area that lends itself to top-roping. The majority of the routes will have to be initially lead. Most of the routes are one pitch or less in length. The main areas are located near Lilly Bridge, a 20 minute drive from the Obed WSR office in Wartburg. Climbing is possible all year with spring and fall being the best times.

Hunting. Catoosa WMA portion of the Obed WSR is open to big game hunts in the fall and spring of the year. Deer, boar, ruffed grouse,

turkey, and raccoon may be hunted in season with a permit from TWRA. Small game such as squirrel and rabbit may be hunted in season as well.

Fishing. The Obed offers a variety of sport fishing opportunities to the public. Most of the rivers have good access but there are spots away from the beaten path where you can find solitude. The four major creeks and rivers that make up the bulk of the fishing areas are Clear Creek, Daddys Creek, Obed River, and the Emory River. These larger Creeks and Rivers provide approximately 40 miles of fishable water in the Obed WSR.

There is a potential to catch as many as fifteen different fish species while fishing within the Obed WSR boundaries. The four species of Black bass present include largemouth, redeye, smalimouth, and the spotted bass (Micropterus puntulatus). Of the bass, the smailmouth is the most abundant and probably the species most sought after by fishermen while the redeye bass has been introduced and occurs in relatively small numbers. Because of their size and allusiveness, the "Musky", a native fish whose population has been supported by the state, provides a unique trophy fishery for the Obed WSR. Sampled species found include: rock bass, bluegill (Leøomis macrochirus), redbreast sunfish, green sunfish (Lepomis cyanellus), warmouth (Lepomis gulosus), longear sunfish, and redear sunfish (Leøomis microlophus). Non-game fish taken for food include: channel catfish (Ictalurus punctatus), flathead catfish (Pylodictis olivaris), yellow bullhead (Ameiurus natais), and freshwater drum (Aplodinotus arunniens).



Water Resource Management Issues

Created in 1976 as part of the federal Wild and Scenic Rivers Act of 1968, the Obed WSR primary purpose is protection and perpetuation of the river system in an essentially primitive condition for public enjoyment. Over the years, while some concerns about the WSR's water resources have diminished, others have increased, and new ones have arisen. Activities both inside and outside of the park unit boundaries raise many issues of concern regarding their impacts on water resources in the Obed WSR and on successful NPS management of those resources for the public.

Issues of concern have been developed from a set of issues identified at a public workshop held in December of 1995, as well as discussions with NPS staff and with other agencies. Citizens generated a total of 145 comments dealing with issues and objectives they consider important to a WRMP. This exceptional level of participation has yielded invaluable information necessary for making sound decisions about WRMP options. Significant categories identified at the public scoping meeting that are related to the water resources of the Obed WSR include:

- Water Issues
  - Water Quantity (flow) - water rights
  - Water Quality (chemical, biological, and physical)
  - Adjacent Land Uses On The Watershed
    - Private Property Rights
    - Water Resources Information
    - Government Regulations
    - Coalition And Coordination Building
- Education/Communication/Interpretation
  - Status Of Water Resources Information
  - Government Regulations And Policies
  - (Water Rights, etc.)
    - Federal
    - State
- Recreation Within The Obed WSR - NPS Unit
- Preservation Of Cultural And Natural Resources
- Outstanding National Resource Waters Designation
- Obed WSR Boundaries And Easements

These have been revised and expanded to aid in forming the basis of this WRMP and can be categorized into two general groups: Programmatic and Specific.

Programmatic issues are concerned with the understanding and management of the water resources of the Obed WSR. These issues require: long-term monitoring of the water resources, biological resources, and land use; and baseline assessment of instream flow needs. Baseline information relating to these areas is fragmented among many different agencies. This data can be consolidated to support more effective decision-making regarding the Obed WSR's water resources. Since the Obed WSR is actually a small portion of the Obed River watershed, water resources within the Obed WSR are primarily impacted by activities outside its boundaries. This results in a need to proactively coordinate and build coalitions, between the Obed WSR National Park Service Unit and other stakeholders in the watershed as a basic component of the WRMP.

Specific issues relate to existing activities and problems. Specific issues are generated by events or actions, and vary widely in scope and impact. They are both internal and external in nature, and require direct responses for alleviation or mitigation. The highest priority project addressing a specific issue is definition of instream flow needs and water rights for the Obed WSR under eastern riparian water law.

Programmatic Issues

The following programmatic issues are considered essential core features of a Water Resources Management Program for the Obed WSR:

Baseline Information

Baseline information regarding water quantity, quality, and land use of the Obed WSR National Park Service Unit, and Obed River watershed is fragmented among various agencies involved with natural resource management in Tennessee. This data is valuable, and in many cases, necessary for management of Obed WSR water resources. These data could be readily accessible in a single database. The first step in achieving inter-agency data coordination will be to identify what detailed water resources related data the NPS and other agencies have and determine what is lacking. Thorough development will include establishing a Geographic Information System (GIS) database which will aid in developing models used to assess effects of activities in the Obed/Emory watershed on water resources within the Obed WSR boundaries. This database will also aid in: identifying and defining park attributes sensitive to perturbations (e.g., instream flow); and residential and commercial developments of potential concern to water management of the Obed WSR.

Inter-agency Data Coordination

The Obed WSR constitutes about 1.5 percent of the watershed. The National Park Service Unit is situated approximately in the lower half of the Obed on the middle third of the Emory River drainages. The high degree of hydrologic interdependence of the Obed WSR and other portions of the watershed, makes coordination with other stakeholders critical for effective water resource management.

It is in the best interest of the Obed WSR, as a major stakeholder in the watershed, to cooperate in the gathering and coordination of water resources data. The hydrologic and ecological databases need to become compatible in format and accessible to all agencies. For example, effective participation in the state's permitting process is important to the protection of Obed WSR water resources. The participation may include providing quantitative, fact-based comments, permit approval or denial or requested monitoring, and mitigation activities.
Several agencies other than the NPS also address water quality and water resource issues in the Obed/Emory watershed. Six agencies (TVA, USGS, USFWS, NRCS, TDEC, and TWRA) are currently conducting various types of data collection (hydrological, biological, water chemistry, etc.).

Opportunities for enhanced coordination of data from current inter-agency activities are numerous. The USGS NAWQA Program has chosen the Obed River as one of it's 59 national study units, and will be collecting detailed stream flow and water quality data. The agency could additionally coordinate with TVA's Ft. Loudon/Melton Hill/Watts Bar River Action Team (RAT). The RAT conducts water quality and biological monitoring of water resources in the Obed/Emory River watershed. The Team also implements water resource improvement projects, and works to build inter-agency and community support for water quality improvement activities and resource protection. NPS could also coordinate with TDEC to obtain monitoring data, information regarding permitting activities in the watershed, and other water resource protection efforts is an important step to implementing objectives of the WRMP. Other agencies, such as the NRCS, conduct water resource-related activities in the abed/Emory watershed. A stronger working relationship between the NPS and NRCS is important, especially with regards to promoting agricultural BMPs to reduce the impact of livestock and farming activities on water quality.

Water Quantity: Hydrologic Inventory and Monitoring

Water is the dominant feature of the Obed WSR. The characteristic natural patterns and variability of flow and water quality have maintained the integrity of stream geomorphology and ecological communities for millennia. As for many rivers, human activities in the watershed are now altering these natural conditions. What and where do alterations manifest? How severe are they? Do they significantly affect the water resources the NPS is mandated to protect and preserve in the Obed WSR? How does the NPS best avoid or mitigate impacts, provide alternatives or influence decisions that affect ecological

and recreational water resources of the National Park Service Unit? Which ones are most important? What are the instream flow needs and water rights of the NPS under eastern riparian water law? These questions inherently require knowledge of the resource as well as the human activities affecting the resources.

To successfully manage water resources of the Obed WSR, long-term monitoring of stream hydrology is a critical component for obtaining this knowledge. Expanding demand for water for regional or municipal water supplies and agricultural uses on the Cumberland Plateau could potentially reduce or substantially alter flow patterns in the 0 bed/Emory River system. These alterations in turn affect the ecological integrity and recreational value of the river. The approximately 2,903 (as of 1994) small impoundments already in the drainage could already be altering low flows and duration of flows.

Depending upon the construction and site characteristics, residential and commercial development or mining activities, such as those occurring in the Obed/Emory watershed can also increase or decrease base flows and ranges of storm water runoff. As private and public development progresses in the watershed, knowledge of hydrology and monitoring of hydrological effects will become of greater importance.

The USGS flow gage located on the Emory River at Oakdale, Tennessee is the only currently operating, long-term (1927-1997) flow gage that exists for the entire Obed/Emory drainage, and it is outside the National Park Service Unit boundaries. These data are currently available on a real-time basis to recreationists through TVA's automated call-in system and the USGS real-time data Worldwide Web page. A second gage, within the boundaries of the Obed WSR was installed as part of the USGS NAWQA program in 1997. Current hydrological gaging is insufficient to even establish baseline hydrology for various reaches of the Obed River drainage within the Obed WSR with certainty. To obtain adequate baseline hydrology for Obed WSR management needs, and to assess effects of developments in the watershed, the current monitoring effort would need expanded to include an additional three stream gages.

Water Quality: Chemical, Biological, and Physical Inventory and Monitoring

Maintaining a water quality monitoring program adequate to fulfill future NPS needs and to influence activities outside the National Park Service Unit boundaries, will require expansion of the current efforts, periodic evaluation, and coordination with other federal, state, and local agencies with water management responsibilities. Evaluation of the water quality program will include assessment of the adequacy of the existing sampling network and water quality parameters to capture events and trends important to protection and maintenance of the integrity of water resources managed by the National Park Service Unit.

The existing water quality monitoring network in the Obed WSR currently meets minimal requirements. With ongoing perturbations (sedimentation, nutrient enrichment, low flows, etc.) in the Obed/Emory watershed, long-term chemical, biological, and physical monitoring is important not only to current management needs for Obed WSR resources, but to improve the water quality and biological communities found in the system. The Obed WSR National Park Service Unit has monitored water quality at ten stations within its boundaries since 1982. The rationale that many state and federal agencies use for emphasizing chemical monitoring is that chemical criteria, developed through toxicological studies of standard aquatic organisms, serves as surrogate measures for monitoring biological integrity (Miller et al. 1988). However, this chemical monitoring alone does not take into account the naturally occurring geographic variation of contaminants, does not consider the synergistic effects of numerous contaminants, nor does it consider the sublethal effects (e.g., reproduction, growth) of most contaminants (Karr 1981). Therefore, this approach does not directly measure the biological integrity of surface waters. As a consequence, changes in other factors such as physical habitat are often limiting and can lead to the decline of biological communities (Karr and Dudley

1981). In such cases, biological integnty is unlikely to be improved by controlling chemical pollution alone (Miller et al. 1988).

The direct monitoring of the “healthy” biological communities is sensitive to changes across a wide array of environmental factors because it has the ability to integrate the effects of many man-induced perturbations such as flow alterations and stream habitat and watershed degradation (Karr 1981; Karr et al. 1986). Biological communities (particularly benthic macroinvertebrates) are also sensitive to low-level disturbances that chemical monitoring may not detect (Chandler 1970). According to the Ohio Environmental Protection Agency (1988), which has adopted bioassessment as part of its water quality monitoring program, numerous attributes of biological communities make them particularly well-suited to define environmental degradation. The structural and physical characteristics of fish and benthic macroinvertebrate communities are considered to be relative to physical and chemical aquatic environmental conditions. They can often be utilized to identify likely causes of any recognizable perturbation of the aquatic biological communities.

Assessment of physical habitat must also play a supporting role with chemical and biological inventory and monitoring. It is used to identify obvious constraints on the potential of the site, help in the selection of appropriate sampling stations, and provide basic information for interpreting biological inventory results. Both the quality and quantity of available physical habitat affect the structure and composition of resident biological communities and their potential as well (Plafkin et al. 1989). The importance of holistic habitat assessment to enhance the interpretation of biological data cannot be overemphasized (Plafkin et al. 1989). Where physical habitat quality is similar, detected impacts can be attributed to particular water quality characteristics related to specific human activities in the watershed.

The TVA and USGS have entered into a cooperative arrangement to develop a long-term biological monitoring program for the abed/Emory watershed (typically in the lower stream reaches). TVA identified four fixed sites within the Obed WSR boundaries (Figure 11 and Table 12) and began sampling them in 1996. Selection of sampling sites was based on two criteria: ratio of discernible habitat types (riffle, run, and pool) present and suitability for assessment of the cumulative effects of pollutants entering the watershed. Sites were selected that included an acceptable ratio of habitat types characteristic of the subject stream. Fish surveys in the Obed River and its tributaries consist of qualitative and/or quantitative collections analyzed using the index of biotic integrity (lBl) (Karr et al. 1986). The lBl is an assessment of environmental quality at a

Table 12. Stream and Location.

Stream	Location
Clear Creek (mile 14.8)	Norris Ford
Clear Creek (mile 8.7)	Waltham Ford
Daddys Creek (mile 2.4)	Devils Breakfast Table
Obed River (mile 20.8)	Potter Ford

stream site through application of ecologically-based metrics to fish community data. Streams also receive an ecological classification based on diversity of intolerant families (mayflies, stoneflies, and caddisflies .EPT) and abundance of tolerant organisms. In 1997, the USGS added an additional site at Alley Ford. This station will be monitored on an annual basis for three years intensively. At the end of three years, it will continue to be monitored at a lower level of intensity (with some field parameters being discontinued).

Land Use Inventory and Monitoring **of the Watershed and Non-federal Lands**

Impacts to water resources in the Obed WSR are the result of land use activities both within and outside its boundaries. Private lands within the Obed drainage are used for agriculture, timber harvesting, oil and gas exploration, mining, and residential development. Early detection of land use changes through monitoring can provide leading edge” warnings of impacts on water resources and provide time needed to address those issues before serious negative impacts occur. The impact of land use activities, including increased residential and commercial development in the upper Obed

and the associated impacts to water quality and quantity in the lower Obed cannot be adequately determined at this time.

Detailed information about land use on non-federal lands that have not been acquired by the NPS and those immediately adjacent to the Obed WSR boundaries is also needed. There are currently about 3,292.7 acres (1,332.5 hectares) of non-federal lands in the Obed WSR project boundaries. Agriculture, mining, logging, and residential development all occur on areas congressionally authorized for inclusion within the Obed WSR boundaries, the TWRA's Catoosa Wildlife Management Area and its associated land uses are also a potential concern to water resources in the Obed WSR. The land uses and activities on these lands should be continually monitored for their effects on NPS managed water resources.

Coordination/Coalition Building

The authorized land of the Obed WSR makes up a small, mid-basin portion of the Obed River watershed. The Obed WSR's well-being is closely intertwined with that of its neighbors. A wide array of land management on public and private lands upstream of the Obed WSR practices occur upstream of the Obed WSR National Park Service Unit. Large subdivisions are being developed within the Obed River watershed, and the population in the area is expected to increase. Lands within and adjacent to the boundaries have been leased for the extraction of coal, oil and gas. Clearing lands for development, oil and gas drilling, and agricultural and residential land activities can impact water quality by causing soil erosion, ground and surface water pollution, and drainage alteration.

A broader focus on watershed-based management of water resources inherently requires ongoing coordination and cooperation with other agencies and stakeholders in the watershed. Partnerships are a key to effective watershed management. This approach has been demonstrated in the Obed River watershed by the successful joint management of the Catoosa Wildlife Management Area between the NPS and the TWRA. At the public workshop, landowners, recreationists and agency representatives all commented that more sharing of information was needed. Coordination and cooperation with landowners, local businesses, special interest groups, developers, and government officials involved in the water resources is essential to keep the Obed WSR National Park Service Unit fully aware of watershed activities. Coordination and cooperation is also important serving as a mechanism for representing interests of the Obed WSR in the complex and, at times, overlapping and seemingly contradictory efforts at water management.

Improved Water Resources Management Plan

The effective management and ultimate "health" of the Obed WSR water resources is intimately linked to influencing land use patterns and practices in the Obed WSR watershed. This potentially difficult task is complicated by the fact that much of the adjacent watershed acreage is not managed by the NPS. Instead, numerous stakeholders ranging from other federal, state, and local agencies, to commercial and other private interests contribute to a conglomerate of diverse management goals and objectives.

In recognition of the necessity to involve non-NPS stakeholders in the protection of Obed WSR resources, the National Park Service Unit management has investigated whether mechanisms exist to begin a coordinated approach for watershed-based water resources management protection. Initial contacts with TVA and EPA (area pioneers with the watershed-based approach) indicate that they and other stakeholders are interested, but resources and staff time to develop an overall strategy are scarce. Currently, coordination and cooperation is occurring at the Obed WSR National Park Service Unit among such agencies as WA, TWRA, and TDEC. However, the discrete offerings of each agency are in need of a central coordination effort to help fully realize cooperative potential. Similar situations are being experienced at other NPS river units such as St. Croix National Scenic Riverway, Buffalo National River, and Delaware Water Gap National Recreation Area.

Despite budget and personnel limitations prohibiting other agencies from taking a lead

coordination role at this time, the NPS still retains a formidable impetus to move toward a coordinated, watershed-based approach. The Obed WSR GMP is strongly aligned with exploring this type of approach. In addition, the NPS Water Resources Division is supporting the investigation of existing water rights and means to protect these rights from injury.

A key realization is that development of a watershed-based water resources protection strategy is not identical to the traditional water resources planning tool - the WRMP. It is an outgrowth of recognizing: 1) the highest degree of interdependence of the well-being of the Obed WSR on activities of other stakeholders in the drainage, and 2) that a proactive, stakeholder-encompassing, mutual gains approach is the most effective, long-term method for protection of water resource in the Obed WSR.

Education

An important element to the success of the Obed WSR National Park Service Unit resource management activities is the development of well thought-out, and publicly reviewed action plans, such as this WRMP. The NPS has always recognized the critical importance of environmental education. Informing the general public, as well as adjacent landowners via educational / interpretive programs, will gain needed support for the National Park Service Unit's programs. In addition, it will provide an informed public with the opportunity to participate in protecting the natural resources of the Obed WSR. The educational / interpretive programs developed by the NPS, in conjunction with WA, should address the water resource management problems associated with water resource issues in the Obed/Emory watershed such as development, agricultural practices, and oil and gas exploration.

Specific Issues

Assessment of Water Rights and Instream Flow Needs

Under eastern riparian water law, the precise nature of the NPS's water rights for the Obed WSR are unclear. It is clear that the United States has riparian water rights within the NPS Unit by virtue of its status as a riparian landowner. The present value of these rights to maintain stream flows and the characteristics of those stream flows maintaining natural conditions need definition.

Special Water Designation and Standards

According to the State of Tennessee's Water Quality Control Act of 1977, it is the State's public policy that the people of Tennessee have a right to unpolluted waters. In the exercise of its public trust over the waters of the state, the government of Tennessee is obligated to take all prudent steps to secure, protect, and preserve this right. One of the means by which the State accomplishes this task is through a special water designation. This designation is entitled Outstanding National Resource Waters or ONRW (as indicated previously), and it provides the highest level of protection available under the Clean Water Act (40 CFR 131.12). Upon recommendation of both public comments and NPS staff ONRW, status will be sought for the waters of the Obed WSR to support efforts to protect resources in the National Park Service Unit.

This designation is designed to protect and maintain existing high water quality while all other water quality standards are based on state designated water uses. These uses allow discharges that degrade water quality so long as the quality remains sufficient to not preclude the designated uses. In accordance, with State Policy, the TDEC recommends to the Water Quality Control Board that certain waterbodies be designated ONRW5. This designation is only given to those waterbodies that are considered to have high quality waters which constitute an outstanding national resource - such as waters of national and state parks and wildlife refuges and water of

exceptional recreational or ecological significance. The Water Quality Control Board must make the designation of ONRW in the State of Tennessee.

Support Information for Water-related Sports

The abundance of water within the Obed WSR boundaries creates ample opportunity for water related activities. The sports of kayaking and canoeing are particularly dependent upon water flows for an enjoyable recreational experience. The USGS currently operates two stream gages, one on the Emory River near Oakdale and the other on Clear Creek near Lilly Bridge (installed in March of 1997), that are sources of information for recreational boaters.

The topography of the Obed WSR also creates an unusually excessive runoff that can create dangerous rapids during heavy rain events. Due to the terrain and stream morphologies of the area, canoeing opportunities are available only during periods of sustained rainfall (creating high flows) or heavy rain events. In the State of Tennessee this sustained rainfall generally occurs between the months of November and May.

At the lower ranges of flow (below 500 cfs) canoeing must be confined to the lower sections of the Obed and the Emory. Flow rates in the 500 to 1000 range open up more exciting (and at this flow rate very technical) middle sections of the Obed. Flow rates above 1000 are required, however, for most of the gorge runs.

Whitewater boating in Daddys Creek ranges from Class II to Class IV rapids. Depending upon precipitation, Class Ill and Class IV rapids can be encountered downstream of the Daddys Creek, Obed River confluence. After Clear Creek joins the Obed, the volume is boosted substantially as well. The only gages presently in place on Clear and Daddys Creeks are recording gages put in place temporarily by WA and Rural Electric Service as part of a joint venture to study the impact an impoundment would potentially have on CJear Creek. These gages are not telemetry gages. Therefore, no “real time” flow

information is available to recreational boaters on these waterways.

Agriculture and Timber Industry

Agriculture in the Obed/Emory watershed represents a potential concern to water quality in the Obed WSR. Though limited in its extent in the entire watershed, some agricultural activities have a significant impact on water resources. Specifically, the growing of snap beans in Cumberland County is an issue. According to Natural Resources Conservation Service personnel, snap bean fields are a significant source of sediment; the fields are cultivated to a fine consistency, making them especially prone to erosion. Land used for snap bean fields are only used for several years, at which point the growers will rotate to other fields in the county. This practice makes it difficult to pinpoint farm areas and to predict and manage water resource impacts through the use of agricultural BMPs.

Landsat imagery provided by WA indicates a significant portion (25 percent) of the Obed/Emory River watershed is devoted to pasture. The potential impact to water resources in the form of increased sedimentation and higher bacterial levels from pastures is a concern.

Logging activities continue to be a scattered, though significant concern to water quality in the Obed WSR. Tennessee Department of Forestry is conducting a survey of logging operations; mapping of logging activities will be completed in 1997. These data would be useful in water resource planning for the Obed WSR, and should be included in any baseline data compilation of land uses.

Continuous Hydrologic Watershed Modeling

Presently the effects of any proposed land use alterations on both water quality and quantity to streams within the Obed WSR are unpredictable. Development of a watershed model and assessing watershed changes as needed will aid in making informed decisions prior to implementing actions that could have watershed impacts.

Abandoned and Active Mines

Abandoned coal mines in the Obed/Emory River watershed impact water resources within the Obed WSR boundaries. Data regarding the location of these mines is fragmented between state and federal agencies. USOSM data indicate a total of 40 mines are located in the two watersheds, and state agencies have data regarding mines permitted before SMCRA legislation was enacted (prior to 1984). Impacts on the water quality of the Obed WSR from active and abandoned mines include increased sedimentation and turbidity, and acid mine drainage. Although coal mining has slowed in the watershed, an acceleration of any mining activity could significantly impact water quality in the Obed WSR.

Oil and Gas Exploration

Although oil and gas exploration in the watershed has declined, some impacts to water resOurces may still continue. At present no monitoring program for oil and gas operations is in place after the initial installation inspection occurs. Active and abandoned oil and gas operations should be included in baseline land use assessment and mapping projects, to assess impacts to the Obed WSR.

Off-road Vehicles

Increased local use of off-road vehicles is intensifying disturbances to soils and vegetation in the Obed WSR. Detailed surveys of ORV trails, mapping of trails, and studies of the impacts of sediment yields from ORV trails are needed to quantify impacts to Water resources.

Effects of Publicly Owned Wastewater Treatment Facility

Effluent from the City of Crossville, Tennessee wastewater treatment facility into the Obed River is a concern for water quality flowing into the Obed WSR National Park Service Unit. Though studies have indicated the effect of dilution diminishes impacts at the point where the Obed River flows into the National Park Service Unit boundaries, as population and residential development increases in the upper

reaches of the Obed River watershed,

additional impacts may appear.

Easement Definitions

The Wild and Scenic Rivers Act designates rivers and their immediate environments to be preserved and protected by securing public ownership in fee or securing easements which limit certain activities and uses and/or which permit public access. Within the Obed WSR, 1,066 acres (431.4 hectares) of the total 5,056 acres (2,046.2 hectares), or 21 percent, are secured through various easements. Generally, the easements:

- provide protection for the existing landscape character;
- restrict advertising, dumping trash, and developing lands and new structures;
- provide for public use along the river and floodplain;
- prohibit new road construction, but permit maintenance of existing roads;
- permit limited agriculture and timber practices on the rim while prohibiting these activities in the gorge; and
- prohibit animal operations with large populations

Contained within the easements is language subject to interpretation: “gorge,” “maintenance,” “floodplain,” some of which has undergone legal review, some of which has not. It is not known whether landowners subject to easements, Obed WSR National Park Service Unit management, and the legal system interpret the restrictions and allowances equally. There is need to educate new landowners when land is exchanged and to verify that easement restrictions are not being violated. It has not been determined whether easement language is sufficient to preserve and protect Obed WSR values. Monitoring impacts of allowable uses needs to occur.

Water Resource Management Program

The importance of growing outside influences on the water resources found within the boundaries of the Obed WSR creates the necessity for the development of a water resources management program that improves on knowledge of existing conditions within and around the Obed WSR. These influences also necessitate monitoring existing conditions and promote an active effort to educate and partner with other watershed users to protect the principal resource of the Obed WSR for future generations.

The nature of the water resources within the Obed WSR are such that none of them can be managed solely by consideration of features or actions within the WSR boundaries. With the boundaries of the Obed WSR following stream corridors, all lands encompassed by its boundaries are part of hydrologic systems which extend beyond the National Park Service Unit. For this reason, the Obed WSR's management efforts must be focused to: first, develop a comprehensive understanding of the structure, function, and condition of its hydrologic systems; define park water rights; and thirdly, effectively coordinate with and influence programs managing activities outside of the Obed WSR which affect Obed WSR resources.

To address water resource issues basic to managing, protecting, and preserving Obed WSR resources, this Water Resources Management Plan has been designed using five identifiable components. These components are considered the nucleus of the Obed WSR's hydrology program:

- Staff and Support Needs
- Inventory and Monitoring
- Cooperation and Coordination
- Data Management
- Specific Water Resource Issues

The following discussion will focus primarily on high priority concerns. The first component defines the adequate staffing needs and expertise necessary to support the other four components of the program. The next three components focus primarily on aspects of the hydrology program. They are critical to understanding the hydrological system of the Obed WSR and surrounding lands. The final component deals with specific water resource issues. With this understanding, it will be possible to address the broader range of specific water resource issues in the fifth component.

Staff and Support Needs

The purpose of this component of the water resources management program is to:

> *identify the adequate number and expertise of water resources staff necessary to implement the program proposed in this plan.*

The current staffing level of the Obed WSR is not sufficient to implement the proposed Water Resources Management Program. The limited staff of the Obed WSR handicaps the National Park Service Unit both in terms of available personnel and expertise required to implement the additional objectives and requirements identified in this program. The Obed WSR Park Service Unit is staffed by four full-time employees. These employees include a Superintendent, Administrative Officer, Maintenance staff person, and one Protection Ranger. Four seasonal positions (including two interpreters, one protection ranger, and one maintenance worker) are hired to provide additional support as funding permits. Current Obed WSR staff positions and staff positions filled on an assistance-upon-request basis from the Big South Fork NRRA are shown in Figure 17.

Many water resources activities must be conducted over sustained periods and require a continuity of knowledge, working relationships, and techniques that can only be accomplished effectively with permanent staff knowledgeable about water resources. Because it is a National Park Service Unit with a small land base, the Obed WSR does not

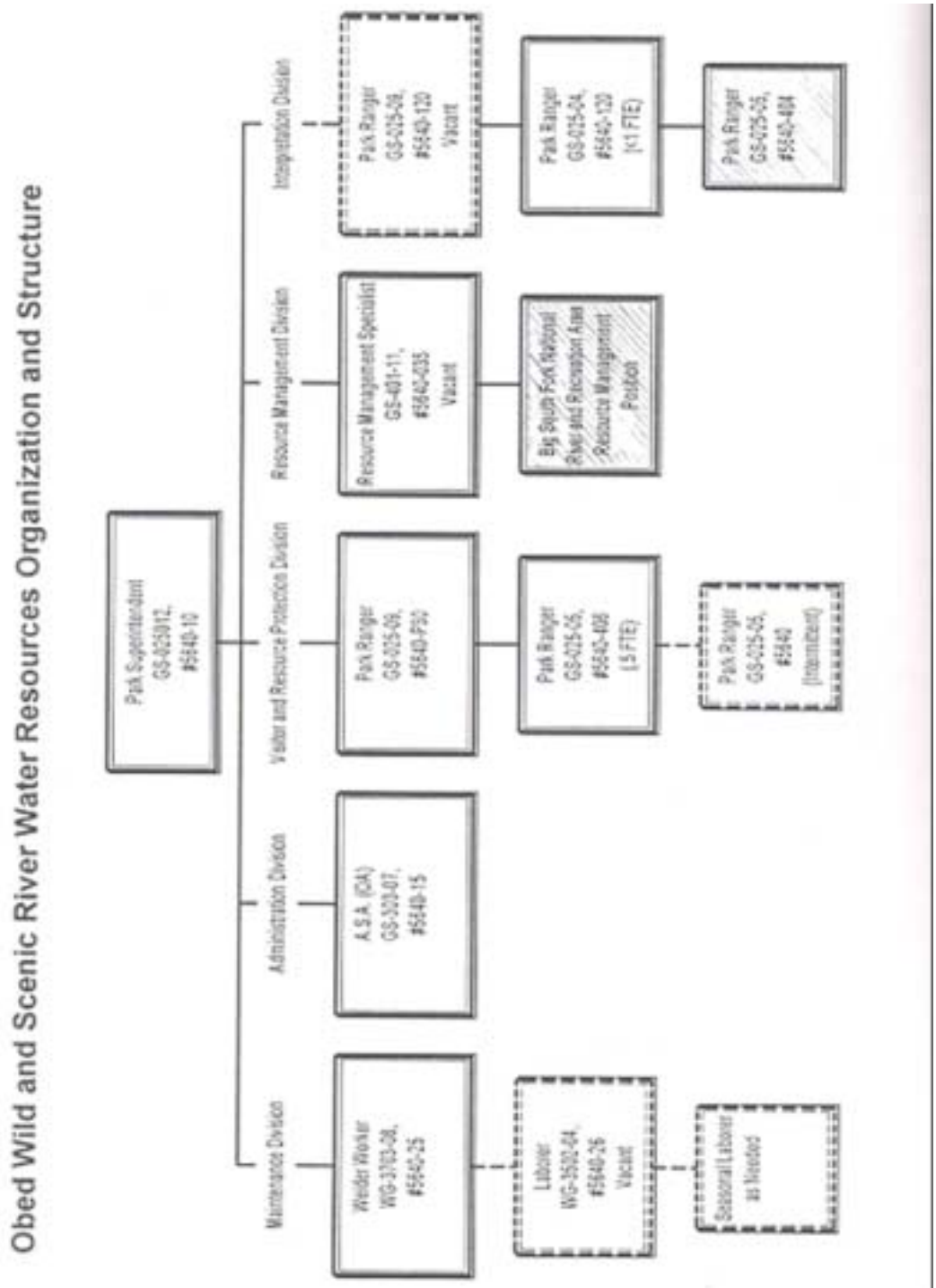


Figure 17. Obed WSR current staff positions and staff positions on an assistance upon-request basis from the Big South Fork National River and Recreation Area (indicated in gray).

envision a large permanent staff, but rather, the development of cooperative and interagency agreements to meet many of its research, inventory and monitoring needs. This will allow the Obed WSR to take advantage of the many initiatives that are currently ongoing or under development by other agencies, without requiring a substantial increase in funding. Implementation of this program will require a combination of an additional full-time position, a seasonal or temporary technician, funds, and support for contracted work. The additional full-time position would be for a Resource Management Specialist. This individual's responsibilities would be to oversee water resource related, cooperative programs with other agencies related to Obed WSR water resources and to initiate dialog with other stakeholders in the Obed WSR watershed in order to better carry out the internal mandates for the Obed WSR. This would include, but not be limited to, monitoring of activities (such as wastewater treatment plants, etc.) on the watershed, participating in local and regional planning,
• and negotiating cooperative agreements, all to make sure that Obed WSR concerns are considered in each of these activities. This will be accomplished through making personnel contacts, formal and informal participation in planning efforts, and preparation of an annual report. The resource manager will also be involved with some data collection in the field and data analysis and the establishment of a resource inventory for the Park Unit that would include citations of actual problems and impacts, and specific descriptions of the number and location of resources.

A full-time Resource Management Specialist in a base-funded position to coordinate the watershed-based water resources protection strategy and overall field related activities dealing with research, inventory, and monitoring is proposed. This would involve coordinating all efforts by other agencies within the boundaries of the Obed WSR and stay abreast of activities in the Obed/Emory River watershed. In addition to the Resource Management Specialist, it is recommended that the NPS provide funding for a seasonal technician with the primary responsibility to provide field support both for water quality and quantity data collection as well as any other
assistance the Resource Management Specialist may require.

There are several avenues for seeking project funds. The project statements presented in each of the other program components are developed specifically for this purpose.

Inventory and Monitoring

The primary purpose for inventory and monitoring is to preserve:

> *"one of the last, free-flowing, wild river systems in the Eastern United States with rugged, generally inaccessible terrain and pristine waters representing a trace of primitive America for the benefit and enjoyment of present and future generations."*

In order to achieve its primary purpose, Obed WSR needs to know considerably more than is currently available about the structure and function of its hydrologic systems and water dependent environments. Current NPS water quality monitoring stations are located only within the Obed WSR boundaries. Flow, water quality, and biological data are being collected from inside and near the Obed WSR by other agencies, but has not yet been linked to the existing hydrologic data. Incorporating these data is a cost-effective way of enhancing the Obed WSR's monitoring program.

The development of an enhanced program of inventory, monitoring and supportive research, may be used to develop status and trends information and causes. The accumulated data should be stored in an accessible database—preferably a GIS. Using this information, Obed WSR management must then work closely and proactively with local, state, and federal planning and regulatory agencies to insure that actions within the Obed WSR, and its watersheds, are compatible with Obed WSR goals, objectives, and rights.

Table 13 (see Project Statements section) summarizes suggested water resource management project statements developed as part of this planning process. These project statements are designed to address the issues identified in the body of this WRMP.

An enhanced and sustained hydrologic monitoring program is essential to the Park Service Unit's operations. Because of the topography of the region, with deeply incised river gorges, water levels can fluctuate rapidly. The existing potential for high flows during storm events and extremely low flows during dry seasons create a wide range of flows in Obed WSR streams. Flooding typically occurs within the watershed due to long, wet periods in winter and spring that saturate the soil, increasing runoff and causing high water levels in the streams. Intense summer storms can also occur which result in flash floods during this period of typically low flow.

Two flow gages presently measure flow in the abed/Emory River watershed (only one of which is currently within the Obed WSR boundaries). It's questionable whether these sites represent all sub-watersheds in the network and capture impacts from local activities. Establishment of three additional sites will provide needed information to measure changes in flow patterns resulting from land use modifications in the watershed.

A long-term water quality inventory and monitoring program using biological, physical, and chemical parameters to supplement and support the hydrologic inventory and monitoring program should be instigated. Water sample locations should ensure the main contributors to the Obed WSR water quality, the Obed River, Clear Creek, and Daddys Creek watersheds, can be monitored for each of these parameters. Coordination with other agencies of a long-term water quality inventory and monitoring program is essential. Cooperators should include WA's RAT, USGS, TWRA and TDEC. The ongoing efforts of these agencies to inventory and monitor biological, physical, and chemical parameters of water quality will complement the NPS program.

Groundwater monitoring is becoming imperative due to the increasing population in the Obed/Emory River watershed. The population of Cumberland County alone grew by 13 percent between 1990 and 1995. An increase in residential development will undoubtedly lead to expanded groundwater pumping. This raises concern that water quantity in the Obed WSR could soon be impacted. Although the watershed hydrological monitoring network includes stream gaging stations for water levels and flows, groundwater level measurements are essentially non-existent.

Recharge is an important consideration in the potential development of groundwater supplies in the abed/Emory River watershed. Seasonal variations in precipitation affect groundwater storage. Low flows typically occur in the fall. These low flows could be compounded by increasing domestic demand for groundwater and could result in long-term, lower than normal flows. This could be detrimental to aquatic life.

For these reasons, groundwater monitoring should be incorporated into the existing hydrologic monitoring network. The most cost effective means by which to accomplish this would be through a cooperative approach with the TDEC and USGS. The NPS could provide field assistance to these agencies for the installation of groundwater monitoring gages and possibly even funding.

Long-term land use monitoring is also necessary to manage the Obed WSR. The diversity of land uses in the vicinity of the Obed WSR National Park Service Unit dictates that water resource planning take into account land uses within the abed/Emory River watershed in addition to within WSR boundaries. Presently, no system is in place to inventory and monitor land uses. Land uses both internal and external to the Obed WSR include: agriculture; forestry; coal mining; oil and gas exploration; quarries; and residential, commercial, and industrial development. Each of these uses impacts the Obed WSR water quality and quantity. Therefore, land use data should be complied from all available sources and requests should be made to the appropriate agencies, planning commissions, and zoning boards to receive information on any new requests for permits or proposed development in the abed/Emory River watershed.

The purchase of (or access to) a GIS workstation for storage and retrieval of all data gathered is also important to the inventory and monitoring component of the Program. All cooperative projects and programs need to insure that appropriate GIS related databases are developed so that the information can be

effectively managed and used. A complete picture of the various inventory and monitoring programs could be organized into one, centralized database by GIS. With the ability to overlay different data sets, GIS could be used to combine land use, land-ownership, biological and cultural resources, water resource monitoring, wetland data, and impoundments information. GIS analysis will give the NPS the ability to model impacts of major projects or land use changes in the Obed/Emory River watershed to the Obed WSR.

Determining if any trends exist that identify changes in the number of boatable days per year could be elevated to a higher priority by the Obed WSR National Park Service Unit. Providing water-based recreation opportunities and their protection should be a major purpose of the Park Unit. Since sufficient flow data exists in TVA's database, the Obed WSR should work towards obtaining this data via Project Statement OBRI-N-206.000.

The following projects address the monitoring component of the Obed WSR's water resources program:

- Assess and Establish Long-term Hydrologic Inventory and Monitoring Network
- Initiate A Groundwater Monitoring Program
- Establish Long-term Water Quality Inventory and Monitoring Program Using Chemical, Biological, And Physical Parameters
- Develop Long-term External Land Use Monitoring Program
- Acquire Access To Geographic Information System (GIS)
- Develop a Continuous Hydrologic Watershed Model
- Determine Trends In The Number Of Boatable Days

Although all of the previously mentioned inventory and monitoring projects are considered to have high priority in the implementation of this WRMP, it is unrealistic to assume that they could all be implemented at the same time. For this reason, it is suggested that they be implemented in the following sequence as funds allow:

1)Land Use Monitoring
2)Water Quality Monitoring
3)Expanded Flow Monitoring
4)Access to a GIS Workstation

In addition, with the Obed WSR's limited staff it will be difficult to implement these programs (even with a Resource Management Specialist). It is therefore recommended that the Obed WSR National Park Service Unit develop cooperative inventory and monitoring programs with the Big South Fork NRRA. With the additional equipment, staff and expertise the Big South Fork NRRA Unit can provide, these programs can be more efficiently managed.

Cooperation and Coordination

The purpose of this component of the water resources management program is to:

> *establish a proactive role for Obed WSR National Park Service Unit in regional water management, in which it can become fully aware of all activities and actions in the watershed that may affect the Obed WSR, and both contribute meaningfully to regional efforts as well as benefit from the results of these efforts.*

The Obed WSR National Park Service Unit should support other efforts ongoing in the region which directly or indirectly complement the NPS program. Examples of mutually beneficial cooperation are the current efforts of the USGS NAWQA Unit (as mentioned), TVA's Ft. Loudoun/Melton Hill/Watts Bar watershed RAT, TDEC, and NRCS. Support for these programs by the NPS should include assistance with logistics, research and collection permits, compliance, data sharing, and collection.

Actions in support of current cooperative efforts with other agencies (particularly USGS's NAWQA Unit) should be another high priority. They represent activities that have developed from proactive policy in the Obed WSR that has responded to issues of concern both within the Obed WSR and of regional significance.

A USGS NAWQA Program site has been located in the Obed WSR, partially because of

the strong relationship between the Obed WSR National Park Service Unit, USGS, WA, TDEC, and TWRA. It is one of 59 national study units where detailed stream flow and water quality data are collected. Objectives of this "pilot" NPS-NAWQA collaborative program are to: 1) establish a cooperative partnership with a national, institutional water quality program, 2) influence monitoring decisions that result in products that address Obed WSR specific water quality issues, and 3) demonstrate the efficiency and effectiveness of NPS-NAWQA collaborations to support future budget initiatives that would permit implementation of this cooperative agreement on a national basis to meet high-priority water quality monitoring needs in parks.

WA's RAT conducts water quality and biological monitoring of water resources in the Obed/Emory River watershed (data is available upon request), implements water resource improvement projects, and works to build inter-agency and community support for water quality improvement activities and resource protection. Working actively with the RAT will allow the NPS to gain additional information about the status of resource conditions and resident aquatic communities, as well as increase public education and support of the WSR.

TDEC's Division of Surface Mining is coordinating an ecological assessment program of streams in mined areas in the Obed River watershed with the USFWS. Valuable ecological data generated by this program will provide additional information to assist NPS in making water resource planning decisions and assessing potential impacts of mining activities on the ecological health of the overall watershed.

NRCS staff is actively involved in agricultural land use assessment, monitoring, and management. A working relationship between the NPS and NRCS is important, especially with regards to promoting agricultural best-management practices to reduce the impact of forestry, livestock and farming activities on water quality.

Long-term coordination/coalition building should be an essential component of the water resources management program in order to
build upon these coalitions and to ensure long-term commitments. In that manner, resources of the Obed WSR will be fully considered in future regional decisions, which directly affect those resources.

The establishment of an Obed/Emory River Basin team is very important to the success of the coordination/coalition building component. This team's first task should be to develop a well-thought out watershed-based, water resources protection strategy to be used as a "blueprint" to coordinate the activities of all stakeholders toward the best possible resource protection scheme. Such an action would foster a cooperative approach through involvement of non-NPS stakeholders in the protection of Obed WSR water resources. Coordination by the team will require action at both management levels (to continually identify and articulate the Obed WSR's role and responsibility in water management) and at the technical level (to supply data needed for management decisions, and to respond to and support such decisions).

Interpretation/educational programs should be developed. Informing the visiting and general public will not only gain needed support for Obed WSR programs, but provide an informed public the opportunity to participate in protecting the natural resources of the Obed WSR. Interpretive programs designed to address issues identified at a public scoping meeting held in December of 1995, will assist in gaining support for Obed WSR programs, and hopefully provide an informed public the opportunity to participate in protecting the natural resources of the Obed WSR.

The following projects are key areas where coordination with the appropriate agencies can result in mutual benefits:

- Support USGS, NAWQA, WA, NRCS, TWRA and TDEC Monitoring Programs and Activities
- Develop Long-term Coordination/ Coalition Building
- Establish An Obed/Emory River Basin Team
- Develop Educational! Interpretive Programs
- Internet Homepage for Obed WSR

Data Management

The purpose of this component of the water resources management program is to:

> *establish data management systems for the acquisition, storage, and retrieval of data and information in a timely and readily-accessible format for internal use and for acquisition by other users.*

In the past, water quality data was stored in DBASE format. Big South Fork NRRA water quality staff is currently transferring this data into ACCESS and EXCEL formats. When completed, the data will be sent to USEPA to be included in the agency's water quality data STOrage RETrieval system (STORED. In this way, the data will be easily accessible by other agencies.

A necessary precursor to an ONRW designation by the State of Tennessee is the development of a numeric baseline of water quality conditions. Big South Fork NRRA water quality staff are currently reviewing existing water quality database and identifying gaps in information and incorrect entries.

The adequacy of existing water quality data should be assessed and incoming data managed. Substantial inter-agency coordination will be required to make data sets compatible with NPS needs and those of other agencies collecting hydrological or water quality data in the Obed/Emory waters. With the number of agencies involved in various aspects of water quality sampling in the Obed/Emory River watershed (as identified in the Inventory and Monitoring section), a wealth of information is becoming available. These data sets need to be assembled into one database in format easily accessible by all external sources. This database should be located in a central area like the Big South Fork NRRA which currently maintains other databases for the Obed WSR. The Big South Fork NRRA currently has the staff and equipment necessary to manage such a database.

The following projects address the issues related to the management of hydrologic and associated data for the Obed WSR:

- Assess Adequacy of Existing Water Quality Data and Manage and Update Incoming Data
- Develop Inter-agency Data Coordination

Specific Water Resources Issues

In contrast to the generally programmatic approach to the previous three components, this component is issue specific. The purpose is to:

> *recognize and address the ever-changing specific issues that have altered, or threaten to alter, the natural water resources regime.*

This plan proposes projects, presented in project statements in the next chapter, to address specific issues at appropriate levels. These issues and corresponding projects are not intended as all-inclusive. New issues will arise in the future, and some others that exist today simply lack the urgency to warrant inclusion at this time. Additionally, issue priorities are likely to change over time.

Eleven projects, listed below, identify actions required with specific water-related issues. Relative priority is based on the known or potential impacts to resources, the current status of knowledge, and manageability of the problem. The highest priority project is the assessment of instream flow needs and water rights for the Obed WSR. The ORNW designation is considered the second highest priority project. The State's Water Quality Control Board grants this designation. The ORNW designation would afford the Obed WSR the opportunity to have the highest degree of water quality protection possible in the State of Tennessee. The designation is designed to maintain existing high water quality while all other state water quality standards are based on state designated water uses. Other projects address identifying, assessing and/or monitoring impacts in the Obed WSR such as abandoned mine lands, silviculture, oil and gas operations, unimproved roads, wastewater treatment facilities, coal seams, and pyritic shales. Two projects (Aquifer Recharge/Discharge Rates and Influence of Groundwater Supply Wells to Stream Recharge, and Develop Emergency Flood Response Plan) do not fall into either of the above categories.

The following additional projects address the specific water resource issues component of the Obed WSR's water resources program:

- Assessment of Water Rights and Instream Flow Needs. Flows within the Obed River basin historically maintained natural conditions for millennia. The relatively recent establishment of many small impoundments and proposals for larger impoundments for consumptive water uses in the watershed, have the potential to affect water resources the NPS is mandated to preserve. Flow characteristics within the Obed WSR which maintain long-term conditions for preservation and management of park resources need better definition. Additionally, the precise nature of NPS water rights for the Obed WSR is unclear under eastern nparian water law in the State of Tennessee. The present value of these rights to maintain stream flows needs to be defined. This project will: 1). obtain legal review and opinion from the NPS's Office of the Solicitor and Water Rights Branch concerning the nature and extent of water rights for the Obed WSR and, 2). conduct studies designed to obtain information on instream flow needs of the Obed WSR; characterize water-dependent natural resources and the potential effects of developments in the watershed.

- Outstanding National Resource Waters Designation. The uses for the Obed River, as currently designated by the State of Tennessee, afford the water of the Obed WSR only limited protection. As a result, activities outside the boundaries of the Obed WSR allow for a certain degree of degradation to continue. It is therefore recommended that the ONRW designation be pursued by the Obed WSR Park Unit through the State of Tennessee's regulatory Process.

- Initiate a Groundwater Monitoring Program. The population in Cumberland County has grown by 13 percent from 1990-1 995, and growth is expected to continue based on current trends. Expanding groundwater pumping due to increasing development in the Obed/Emory River watershed raises concern that water quantity in the Obed WSR could soon be impacted. This project will require incorporation of a groundwater monitoring component into the existing hydrologic monitoring network.

- Study the Influence of Groundwater and Groundwater Recharge. Quantitative information concerning aquifer recharge and hydraulic characteristics is necessary to manage the development of groundwater resources. The increased installation of groundwater supply wells adjacent to streams both inside and outside of park boundaries could result in reduced groundwater recharge and alteration of natural stream flows. This project will require an estimation of aquifer recharge/discharge rates near streams within the Obed WSR watershed. Existing groundwater withdrawals within the watershed will have to be quantified. Additionally, protocols for evaluating future groundwater supplies within the watershed will have to be developed.

- Develop a Continuous Hydrologic Watershed Model. Presently the effects of any proposed adjacent land use and monitoring alteration on both water quantity and quality on basin streams within the Obed WSR are unpredictable. The objective of this model is to predict how land use changes in the watershed (due to development, agriculture, etc.) will impact flow prior to a change actually being implemented.

- Assess and Mitigate Silvicultural Impacts. Silviculture practices outside of the Obed WSR boundaries have, through increased sedimentation, the potential to affect the quality of waters entering the Obed WSR. The Obed WSR Park Unit should coordinate with TDEC Department of Forestry in order to develop a detailed inventory of external silviculture practices and to identify those that pose potential threats to water resources of the Obed WSR.

- Monitor and Mitigate Impacts of Oil and Gas Operations. Active oil and gas operations both inside and outside Obed WSR boundaries pose a threat to it water resources. This program will require the Obed WSR to work closely with the oil and gas operators during all exploration, drilling and production operations. The object is to provide and early warning monitoring network of the local water resources.

- Assess the Impacts from both Surfaced and Unsurfaced Roads. There are approximately twelve miles of unimproved roads located within the Obed WSR boundaries. The total mileage of unimproved roads within the Obed/Emory River watershed is unknown but believed to be quite large. This project will include the inventory of unimproved roads within the Obed/Emory River watershed, along with monitoring the associated impacts. The objective of this program is to identify sites that are significantly degrading the water resources.

- Assess the Impacts of Coal Seams and Pyritic Shales on Water Quality. The Obed WSR watershed is underlain by coal seams and pyritic shales (e.g., Whitwell Shale) that, when disturbed or exposed, can seriously degrade surface and groundwater quality. This project will include quantifying discrete and cumulative water resource problems as they relate to existing mining and construction activities. In addition, it will require classification and location of problematic coal seams and pyntic shales in three dimensions to permit identification of potential problems due to formation exposure/disturbance.

- Internet Homepage for Obed WSR. Canoeing and kayaking constitute the major use of the Obed WSR. Only limited and not easily accessible information on flow gaging and water quality is presently available to recreational users of the Obed WSR water resources. This project will involve the development of an Internet home page in order to relay Obed WSR flow gaging and water quality information to recreational users.

- Determine Trends in the Number of Boatable Days Approximately 5,000 float visits per year at the Obed WSR constitute one of the major Park Unit uses. This project is designed to determine whether or not impoundments have an impact on the number of boatable days by analyzing existing data against rainfall and impoundment data do determine trends.

Project Statements

Project Statements

The 22 programmatic and specific projects cited in the Water Resources Management Plan are listed below in order of current priority and are summarized in the following table (see Table 13). These priorities, however, are likely to change as tasks are completed, more is learned about the hydrology of the system, and decisions are made internally and externally affecting the relative urgency of various issues.

The projects are also listed in greater detail in the Project Statements chapter. In the standard format of the National Park Service programming documents. These documents used within the National Park Service to compete with other park projects for funds and staff.

OBRI-N-201	Determine Water Rights and Instream Flow Requirements
OBRI-N-202	Support USGS NAWQA Monitoring Program and Activities
OBRI-N-203	Assess Adequacy of Existing Water Quality Data and Manage and Update Incoming Data
OBRI-N-204	Establish Long-term Water Quality Inventory and Monitoring Program Using Chemical, Biological, and Physical Parameters
OBRI-N-205	Outstanding National Resource Waters Designation
OBRI-N-206	Develop Inter-agency Data Coordination
OBRI-N-207	Develop Education and Interpretative Programs for Water Resources
OBRI-N-208	Develop Long-term Coordination/Coalition Building
OBRI-N-209	Establish an Obed/Emory River Basin Team
OBRI-N-210	Assess and Establish Long-term Hydrologic Inventory and Monitoring Network
OBRI-N-21 I	Initiate a Groundwater Monitoring Program
OBRI-N-212	Study the Influence of Groundwater and Groundwater Recharge
OBRI-N-213	Acquire Access to Geographic Information System (GIS)
OBRI-N-214	Develop a Continuous Hydrologic Watershed Model
OBRI-N-215	Develop Long-term External Land Use Monitoring
OBRI-N-216	Assess and Mitigate Silvicultural Impacts
OBRI-N-217	Monitor and Mitigate Impacts of Oil and Gas Operations
OBRI-N-218	Assess the Impacts from Both Surfaced and Unsurfaced Roads
OBRI-N-219	Assess the Impacts of Coal Seams and Pyritic Shales on Water Quality
OBRI-N-220	Inventory Active and Abandoned Mine Lands Impacting Obed WSR Water Quality and Assess Extent of Impact
OBRI-N-221	Internet Homepage for Obed WSR
OBRI-N-222	Determine Trends in the Number of Boatable Days

Table 13. Summary Table of Project Statements.

PROJECT NUMBER	PROJECT NAME	ISSUES ADDRESSED	PROBLEM SUMMARY	SUMMARY OF PROPOSED ACTIONS
OBRI-N-201	Determine Water Rights and Instream Flow Requirements	Water Rights Information Gathering	It is possible that existing and potential upstream impoundments of surface water in the Obed River watershed threaten the free-flowing condition of the Wild and Scenic River the National Park Service is mandated to protect.	1. Obtain legal review and opinion from the Office of the Solicitor concerning the nature and extent of the NPS's rights for Obed WSR. 2. Studies designed to obtain information that will assist the NPS in: (a) Determining the effects of existing and future impoundments on the flow of the Obed Rvier and its tributaries. (b) Characterizing water-dependent natural resources found in Obed WSR. (c) Estimating the effects of the impoundments on the water-related natural resources or recreational activities.
OBRI-N-202	Support USGS NAWQA Monitoring Program and Activities	Internal and Inter-agency Data Coordination Baseline Information Water Quantity: Hydrologic Inventory and Monitoring Water Quality Inventory And Monitoring Program Using Chemical, Biological, and Physical Parameters Coordination and Coalition Building	The USGS NAWQA Program has chosen the Obed River as one of 59 national study units. Detailed water quality and hydrologic monitoring will be collected, to describe trends in national water quality; this data will be especially important to the NPS in assessing water resource impacts to the Obed WSR and implementing protection mechanisms.	1. Provide data and staff support, as needed, to USGS NAWQA Program. 2. Participate in interagency coordination meetings to share data and findings from study sites. 3. Obtain data gathered from study and input into baseline database (GIS). 4. Utilize NAWQA data to assess potential water quality problems.

Table 13. Continued.

PROJECT NUMBER	PROJECT NAME	ISSUES ADDRESSED	PROBLEM SUMMARY	SUMMARY OF PROPOSED ACTIONS
OBRI-N-203	Assess Adequacy of Existing Water Quality Data and Manage and Update Incoming Data	Internal and Inter-agency Data Coordination Baseline Information	The development of a numeric baseline of water quality conditions is a necessary precursor to an Outstanding Resource Waters designation by the State. Additionally, present water quality data is not stored in a format easily accessible by other agencies.	1. Develop numeric baseline of water quality conditions in support of ONRW designation. Necessary research to support ONRW standards includes: a) Conduct preliminary analyses on the Obed WSR's historical water quality data to determine if it is sufficient to characterize the ambient water quality conditions, during the designated baseline period, for specific areas of the Obed WSR. This must include key parameters, and represent natural spatial and seasonal variability. b) Where the database is inadequate for the baseline year, identify an alternative period that, based on continuity of land and water use patterns and the available data record, is representative of ambient water quality during the baseline period. c) Employ appropriate statistical techniques to derive confidence interval estimates for the data. A confidence level of 0.95 or greater should be used, if possible. 2. Assemble data available from the Obed WSR and from external sources. 3. Obed WSR staff should work to insure that the task of entering Obed data into a STORET-compatible format is completed by the NPS as expeditiously as possible. 4. Develop long-term monitoring strategy and protocols for data management and for water quality/quantity information collected from all sources. 5. Incorporate water quality data collected from external sources into the Obed WSR's water stage database/GIS. 6. Develop and implement procedures for the exchange of water quality data from the various external sources on a scheduled frequency. 7. Use the results of the assessment to supplement the data collected from Long-term Hydrologic Inventory and Monitoring.
OBRI-N-204	Establish Long-term Water Quality Inventory and Monitoring Program Using Chemical, Biological, and Physical Parameters	Internal and Inter-agency Data Coordination Baseline Information Coordination and Coalition Building Water Quality Inventory and Monitoring Program Using Chemical, Biological, and Physical Parameters	With ongoing perturbations in the Obed/Emory watershed (e.g., sedimentation, nutrient enrichment, low flows, etc.), long term biological and chemical monitoring is of paramount importance in order to monitor the impact to water quality, fisheries and aquatic biological resources due to both natural and human-induced activities occurring inside the Obed WSR and from sources upstream.	1. Implement strategy developed in Project Statement OBRI-N-203. 2. Inventory fish and benthic macroinvertebrate communities in order to detect and monitor of changes in biological diversity, species composition, and relative abundance of aquatic organisms in response to natural causes (e.g., floods, droughts, etc.) and human-induced events (e.g., previous grazing, prescribed natural fires, and other land-use activities). Monitoring would continue as a cooperative effort of NPS, USGS, TVA, and TDEC for a period of three to five years at which time it could be reduced to semi-annually. 3. Coordinate inventory and monitoring of chemical, biological, and physical parameters, within the Obed WSR Park Service Unit, with federal, state, and local agencies. 4. Establish a database over a period of three to five years. 5. Analyze and attempt to determine the cause of impacts

Table 13. Continued.

PROJECT NUMBER	PROJECT NAME	ISSUES ADDRESSED	PROBLEM SUMMARY	SUMMARY OF PROPOSED ACTIONS
OBRI-N-205	Outstanding National Resource Waters Designation	Internal and Inter-agency Data Coordination Baseline Information Water Quality Inventory and Monitoring Program Using Chemical, Biological, and Physical Parameters Watershed-based Water Resources Protection Strategy	State Protected Water Uses allow discharges that degrade water quality so long as the quality remains sufficient to not preclude the designated uses. Outstanding National Resource Waters Designation is designed to protect and maintain existing high water quality.	1. Work to ensure that the Obed WSR National Park Service Unit is on the state's mailing list for notification of dates and locations for its triennial review for special water designations. 2. Preparation of a formal request for redesignation, and submission to the TDEC. 3. Participate in the state's triennial review process for special water designations. 4. Provide support to the state in its analysis of benefits and costs of an ONRW designation. 5. Coordinate with, and where necessary provide testimony to, the state Water Quality Control Board.
OBRI-N-206	Develop Inter-agency Data Coordination	Internal and Inter-agency Data Coordination Water Quantity: Hydrologic Inventory and Monitoring Water Quality Inventory and Monitoring Program Using Chemical, Biological, and Physical Parameters Land Use Inventory and Monitoring Program Watershed-based Water Resources Protection Strategy	With federal, state, and local agencies involved in research and monitoring programs within the Obed/Emory watershed, coordinating the collection of data as well as managing historical data will promote a more thorough knowledge of the watershed and prevent redundancy.	1. NPS should participate in the coordination of data collection and management between TVA, USGS, NRCS, USFWS, TWRA, TDEC, and local utilities to maximize efficiency. 2. Obed WSR staff enter water quality data into the EPA's STORET database so it can be summarized in their Baseline Water Quality Data Inventory and Analysis Reports and permanently archived for use by states and other parties interested in Obed WSR water quality. 3. Develop protocols for data collection and analysis so data sharing can take place. 4. Produce a semi-annual report in order to encourage timely gathering and analysis of NPS data, and also puts it in a form that is useful for the superintendent and other agencies.
OBRI-N-207	Develop Education and Interpretative Programs for Water Resources	Coordination / Coalition Building Education	The public scoping meeting, held at the onset of the WRMP development identified the public's information and educational needs as they relate to water resources in the Obed WSR.	1. Develop programs and displays designed to disseminate information on NPS policies and programs. 2. Programs tied to the water resource management problems associated with water resource issues in the Obed/Emory watershed such as development, agricultural practices, and oil and gas exploration. 3. Coordination both at management and technical levels with state, local and federal agencies and watershed user groups.

Table 13. Continued.

PROJECT NUMBER	PROJECT NAME	ISSUES ADDRESSED	PROBLEM SUMMARY	SUMMARY OF PROPOSED ACTIONS
OBRI-N-208	Develop Long-term Coordination / Coalition Building	Internal and Inter-agency Data Coordination Baseline Information Coordination / Coalition Building Education	The presently authorized land base of the Obed WSR makes up a small portion of the Obed River watershed. Land management practices on public and private lands upstream of the Obed WSR effect the quality of the Obed River within the Park Service Unit's boundaries. No true mechanisms are in place to effectively begin a coordinating/coalition building approach for watershed-based water resources management.	1. Initiate a central coordination effort to help fully realize cooperative potential between agencies. 2. Pursue coalitions between the Obed WSR and adjacent private property owners to gain support and access to federal lands. 3. Develop programs designed to encourage BMP use on private lands. 4. Stay abreast of land uses and activities on TWRA's Catoosa Wildlife Management Area for control and management. 5. Encourage regular information sharing with regulatory agencies. 6. Develop a cooperative relationship with the Southern Appalachian Man And The Biosphere (SAMAB) foundation. SAMAB focuses on the Southern Appalachian Biosphere Reserve. The program its involved with encourages the utilization of ecosystem and adaptive management principles. The vision of the program is to: promote the achievement of a sustainable balance between the conservation of biological diversity, compatible economic uses and cultural values across the Southern Appalachians. It is hoped that this balance will be achieved by collaborating with stakeholders through information gathering and sharing, integrated assessments, and demonstration projects directed toward the solution of critical regional issues. The SAMAB Foundation will help raise funds, but to date it has not been successful in raising enough funds to significantly support regional projects, needed staff, and administrative expenses. The funds that the Foundation has raised have been used to support programs/projects; but much more is needed. 7. Support the establishment of a pilot inter-agency Cooperative Ecosystem Study Unit (CESU) at the University of Tennessee/Knoxville. CESU is an inter-agency program that utilizes the services of one scientist from each agency involved in their support. These Units are dedicated to mission-oriented research. 8. Accomplishing Project Statements: OBRI-N-202, N-203, N-204, N-205, N-206, N-207, N-209, N-210, N-211, N-212, N-215, N-216, N-218, N-219, N-220, N-221, N-222. 9. Develop brochures dealing with the potential effects of development (i.e., residential construction, etc.) to the Obed WSR's water resources. 10. Develop exhibits dealing with the potential effects of development (i.e., residential construction, etc.) to the Obed WSR's water resources. 11. Develop water use interpretive programs designed to make the general public aware of the importance of protecting the integrity of the Obed WSR's water resources for wildlife, water-related recreational activities, etc..

Table 13. Continued.

PROJECT NUMBER	PROJECT NAME	ISSUES ADDRESSED	PROBLEM SUMMARY	SUMMARY OF PROPOSED ACTIONS
OBRI-N-209	Establish an Obed/Emory River Basin Team	Internal and Inter-agency Data Coordination Baseline Information Coordination/Coalition Building Land Use Inventory and Monitoring Program Watershed-based Water Resources Protection Strategy	The effective management of Obed WSR water resources is intimately linked to influencing land use patterns and practices in the Obed WSR watershed. This potentially difficult task is complicated by the fact that much of the adjacent watershed acreage is not managed by the NPS. Instead, numerous stakeholders ranging from other federal, state, and local agencies, to commercial and other private interests contribute to a conglomerate diverse management goals and objectives.	1. Establish a watershed planning team including major stakeholders and users of water resources in the Obed/Emory watershed. 2. The first task of the team would be to develop a watershed-based, water resources protection strategy to be used as a "blueprint" for coordinating the activities of all stakeholders. The blueprint may serve as a valuable example of innovative management to other NPS entities which are now grappling with the development of new management tools for changing times and changing paradigms. The actual implementation of this project will consist of choosing a NPS staff member (preferably the proposed Obed WSR, Resource Management Specialist - see Staff And Support Needs) who is capable of identifying an exhaustive list of stakeholders; developing a logical strategy for stakeholder involvement through which the water resources threats and the means to protect Obed WSR water resources are identified and prioritized; motivating a commitment on the part of stakeholders who may serve as the most appropriate lead on a particular issue; developing a framework for strategy implementation and operations; and devising a mechanism(s) which is (are) capable of keeping all stakeholders informed and insuring that all stakeholder input is heard. 4. Cooperative implementation of the strategy.
OBRI-N-210	Assess and Establish Long-term Hydrologic Inventory and Monitoring Network	Internal and Inter-agency Data Coordination Baseline Information Water Quantity: Hydrologic Inventory and Monitoring	The increase in external influences (i.e., nutrient enrichment, sedimentation and particularly headwater impoundments) on the Obed WSR's watersheds warrants long-term hydrologic inventory and monitoring to determine the effects on the Obed WSR from watershed modifications.	1. Assess the adequacy of existing stream gaging in the Obed WSR and the Obed/Emory watershed. 2. Likely install three stream gaging stations (Daddys Creek @ Antioch Bridge, Obed River @ Alley Ford, Obed River @ Adams Bridge) for a period of three to five years to collect baseline streamflow data for use in quantifying the effects of watershed modification. 3. Acquire existing water stage data from external sources (i.e., TVA, USGS, TDEC). 4. Identify appropriate water stage data for Obed WSR 's water stage database 5. Coordinate with USGS in the placement and monitoring of gages. 6. Model hydrologic network (which will allow the fine-tuning of future monitoring efforts).
OBRI-N-211	Initiate a Groundwater Monitoring Program	Water Quantity: Hydrologic Inventory and Monitoring	Expanding groundwater pumping due to ever-increasing development in the Obed/Emory watershed raises concern that water quantity in the Obed WSR. Although the watershed hydrological monitoring network includes stations for gaging stream levels and flows, integral groundwater level measurements are essentially nonexistent.	1. Coordinate with TDEC and USGS in order to obtain the following information on the watershed: the number of wells, trends in numbers of wells, location of wells, amount of pumping, and water tables. 2. Determine the hydrologic regime before the study and coordinate the installation of groundwater monitoring wells and staff plates with TDEC and USGS. 3. Identify appropriate locations and methods for groundwater monitoring in conjunction with the existing monitoring network. 4. Establish protocols for obtaining groundwater monitoring data from TDEC and USGS. 5. Analyze results of groundwater and surface water monitoring for use in Project Statement OBRI-N-219. 6. Incorporate the results into NPS-useful format and identify criteria designating "problem areas."

Table 13. Continued.

PROJECT NUMBER	PROJECT NAME	ISSUES ADDRESSED	PROBLEM SUMMARY	SUMMARY OF PROPOSED ACTIONS
OBRI-N-212	Study the Influence of Groundwater and Groundwater Recharge	Water Quantity: Hydrologic Inventory and Monitoring	Quantitative information concerning aquifer recharge and hydraulic characteristics is necessary to manage the development of groundwater resources. These characteristics are poorly defined for the aquifers of the Obed WSR. The increased installation of groundwater supply wells adjacent to streams both inside and outside of Obed WSR boundaries can result in reduced groundwater recharge and alteration of natural stream flows. Considering that present cumulative impacts of groundwater withdrawals is unknown, and future groundwater supply wells for industry and municipalities might be targeted toward higher yield locations (i.e., near streams), an assessment of potential impacts is warranted.	1. Due to the lack of information, seek technical assistance to locate any bits of real data or expert opinions that might be available. 2. Seek technical assistance from NPS Water Resources Division to develop protocols for evaluating future groundwater supplies based upon aquifer characteristics, stream recharge, and stream sensitivity. 3. Analyze results of groundwater (Project Statement OBRI-N-211) and surface water monitoring to estimate aquifer recharge/discharge rates near streams and identify base flow component for water balance. 4. Obtain groundwater supply data from Tennessee Department of Environmental Quality to quantify existing groundwater withdrawals within the watershed. 5. Explore the legal aspects of the problem to determine if any laws and regulations for managing groundwater offer any remedies for problems that are discovered in this study.
OBRI-N-213	Acquire Access to Geographic Information System (GIS)	Internal and Inter-agency Data Coordination Baseline Information Land Use Monitoring Program Water Quantity: Hydrologic Inventory and Monitoring Water Quality Inventory and Monitoring Program Using Chemical, Biological, and Physical Parameters	The Obed WSR has no centralized database in which to maintain information about land use, land ownership, biological and cultural resources, water resource monitoring, wetland data, and impoundments. A GIS would allow the NPS to keep detailed records, map Obed WSR boundaries and ownership patterns, and to model impacts of land use changes in the lands external to the Obed WSR.	1. Key resource management personnel attend a GIS orientation program. 2. Acquire access to a GIS workstation and platform appropriate for the needs of the Obed WSR and obtain staff time to enter and analyze data. 3. Determine data needs for GIS coverages (e.g. slope, topography, soils, Obed WSR boundaries; watershed boundaries; land ownership within the Obed WSR; land uses within the Obed WSR and in the overall watershed; road network; locations of mines/quarries/abandoned and active oil and gas wells; impoundments; water quality monitoring sites and data; biological monitoring sites and data). 4. Coordinate with state and federal agencies to acquire and share existing data or GIS resources. 5. Input data into GIS. 6. Utilize data in ongoing Obed WSR National Park Service Unit's decision-making and to determine areas where the potential for impacts to the Obed WSR 's water resources exist.

Table 13. Continued.

PROJECT NUMBER	PROJECT NAME	ISSUES ADDRESSED	PROBLEM SUMMARY	SUMMARY OF PROPOSED ACTIONS
OBRI-N-214	Develop a Continuous Hydrologic Watershed Model	Baseline Information Continuous Hydrologic Watershed Modeling	Presently the effects of any proposed adjacent land use and monitoring alterations on both water quantity and quality on basin streams within the Obed WSR are unpredictable.	1. Develop hydrologic watershed model (based on NPS, TVA, and USGS data) in order to model both water quantity and water quality and continuously update the hydrologic model using land monitoring data, etc.. A description of the Park Unit, rivers and watershed will be necessary in order to construct this model. 2. Input land monitoring data into the model to quantify the effects of proposed land use changes on basin streams. 3. Use the outputs of the watershed model to predict the potential affect from watershed land use changes.
OBRI-N-215	Develop Long-term External Land Use Monitoring	Internal and Inter-agency Data Coordination Baseline Information Land Use Inventory and Monitoring Program	Impacts to water resources in the Obed WSR are the result of land use activities both within and outside of the Obed WSR. Presently, no system is in place for inter-agency coordination of activities in the watershed.	1. Historic and current land use data including aerial and Lansat imagery is not maintained by the Obed WSR. Compile for inclusion in GIS/baseline assessment. 2. The Obed WSR Park Service Unit should take a proactive approach on land use decisions. This would include actively searching public notices, participating in planning and zoning meetings, getting on mailing lists for notification of planning efforts, and reviewing state NPDES discharge permit applications. This task will require a commitment of time from the superintendent and resource manager, and some travel funds. 3. NPS contacts should be placed on notification lists for mining permits, TDEC Water Pollution Control public notice list, U.S. Army Corps of Engineers public notice list, as well as local planning commissions and zoning boards who are responsible for review and approval of development. 4. Update land use information into the GIS database as it becomes available.
OBRI-N-216	Assess and Mitigate Silvicultural Impacts	Agriculture and Timber Industry	Obed WSR waters are subjected to increased sedimentation as a result of small-scale forestry operations outside the WSR boundary.	1. Coordinate with TDEC's Department of Forestry to inventory the total private and commercial acreage devoted to silviculture operations upstream of the Obed WSR. 2. Working with TDEC's Department of Forestry, identify locations of silviculture operations that may be impacting the WSR's water resources. 3. Develop a cooperative relationship with TDEC's Department of Forestry so as to allow for better information exchange concerning silvicultural practices in the watershed. 4. Assess usage of silvicultural BMPs within the Obed/Emory watershed. 5. A GIS layer of silvicultural practices (both current forest cover with annually or bi-annually updated scenes) needs to be developed or procured and incorporated into the Park Unit's GIS in order to track land-use change and water quality relative to silvicultural activities. Information on this GIS map should include the location of the chip mill, the watershed and sub-watersheds, roads, rivers, WSR boundary, and areas existing and potential timber harvesting. Other aspects of the setting to include are the amount of timbering currently occurring and observed impacts. This element is predicated on the Obed WSR having access to GIS. See Project Statement OBRI-N-213. 6. Assess impacts of current and future cultivation and harvest of timber and develop a program to effectively interact with silvicultural industry in the watershed to maximize use of Best Management Practices.

Table 13. Continued.

PROJECT NUMBER	PROJECT NAME	ISSUES ADDRESSED	PROBLEM SUMMARY	SUMMARY OF PROPOSED ACTIONS
OBRI-N-217	Monitor and Mitigate Impacts of Oil and Gas Operations	Oil and Gas Exploration	Active oil and gas operations both inside and outside Obed WSR boundaries pose a threat to its water resources.	1. With input from TDEC's Department of Geology, identify the locations of active and abandoned oil and gas operations in the Obed watershed, for inclusion in baseline land use assessment and mapping projects. 2. Since the locations of oil and gas operations are not accurately known by the NPS, when determined, include the exact location of the operations relative to the Obed WSR boundaries on a GIS map to assist in determining their potential for impact to water quality. 3. Document and describe any observed spills, road erosion or other impacts and immediately report them to the TDEC. This can best be accomplished by field reconnaissance, contacts with operators, annual site visits, and technical assistance from the NPS Geologic Resources Division. 4. Develop and implement plans to identify and assess impacts of oil and gas operations inside Obed WSR boundaries. 5. Verify and monitor proper road construction and disposal of waste material. 6. Develop and implement mitigation projects addressing identified impacts. 7. Design and implement a system to readily reclaim inactive sites located within the Obed boundaries.
OBRI-N-218	Assess the Impacts from both Surfaced and Unsurfaced Roads	Land Use Inventory and Monitoring	Sedimentation from unimproved roads is a potential water quality threat to the Obed WSR. Presently no protocol exists for measuring impacts from unimproved roads within the Obed WSR boundaries.	1. Use aerial photographs to determine the location and total mileage of surfaced and unsurfaced roads within the Obed/Emory watershed and classify them based on width and surface condition. 2. Use GIS techniques to identify areas of concern based on soil types, slope, hydrology, and occurrences of roads. 3. Develop impact criteria and monitoring strategy to assess effects of surfaced and unsurfaced roads receiving high priority status inside Obed WSR boundaries. 4. Identify, prioritize, and monitor impacts of surfaced and unsurfaced roads inside Obed WSR boundaries for inclusion in baseline lands use assessment and mapping project. 5. Work with counties, communities and land owners to develop mitigation plans as needed. 6. Report observed violations (i.e., collapsed silt fences, etc.) outside the Park Unit boundaries to TDEC.

Table 13. Continued.

PROJECT NUMBER	PROJECT NAME	ISSUES ADDRESSED	PROBLEM SUMMARY	SUMMARY OF PROPOSED ACTIONS
OBRI-N-219	Assess the Impacts of Coal Seams and Pyritic Shales on Water Quality	Water Quality: Chemical, Biological, and Physical Inventory and Monitoring	The Obed WSR watershed is underlain by coal seams and pyritic shales (e.g., Whitwell Shale) that when disturbed or exposed, can adversely affect surface and groundwater quality. Disturbance of these geologic formations results from mining activities (e.g., coal, gravel, and sand) and general construction activities. The primary problem associated with mining and disturbance of these formations is the production of acidic leachate and runoff due to the oxidation of pyritic materials. High acidity also poses the potential of leaching heavy metals from the rocks. Many discrete and cumulative impacts of formation disturbance to surface and groundwater are unknown. This is primarily due to staff limitations of monitoring agencies, inadequate monitoring protocols and sampling networks, indifference to regulations, poor reclamation practices, and/or lack of understanding by mine operators. Therefore, it is important to identify the locations of problematic formations in three dimensions, and quantify existing water resource problems as they relate to mining and construction activities.	1. Classification of coal seams and pyritic shales based upon geological data and historical evidence of surface and groundwater quality impacts. 2. Literature review and examination of federal and state records to catalog existing mine and construction sites that intersect coal seams and pyritic shales. 3. Compile and review water quality monitoring data from catalogued sites. 4. Geologic mapping of problematic coal seams and pyritic shales using available digital elevation model (DEM) data and boring data. 5. Numerical modeling to predict potential impacts (discrete and cumulative) to water resources of the watershed based upon contaminant loading to surface and groundwater. 6. Identify and document those seams and shales, which if disturbed, have significant potential to cause impacts to water quality of the Obed WSR. This information will be used to comment on regulatory permits for proposed mining, development and construction in the watershed.
OBRI-N-220	Inventory Active and Abandoned Mine Lands Impacting Obed WSR Water Quality and Assess Extent of Impact	Abandoned and Active Mines	Obed WSR waters are subjected to increased acidity and erosion as a result of active and abandoned mine lands from outside its boundaries.	1. Identify locations of active and abandoned mined lands in the Obed watershed. 2. Coordinate with OSM and TDEC's Mining and Geology sections to identify impacts. 3. Input this data into baseline lands use assessment and mapping project. 4. Prioritize the need for reclamation on active and abandoned mine locations based on likely impact to Obed WSR waters. 5. Coordinate with OSM and TDEC's Mining and Geology sections to recommend reclamation and mitigation procedures.

Table 13. Continued.

PROJECT NUMBER	PROJECT NAME	ISSUES ADDRESSED	PROBLEM SUMMARY	SUMMARY OF PROPOSED ACTIONS
OBRI-N-221	Internet Homepage for Obed WSR	Continuous Hydrologic Watershed Modeling Water Quantity: Hydrologic Inventory and Monitoring Education Recreation	Only limited and not easily accessible recreational support with flow gaging and water quality information is presently available.	1. Work with NPS communication specialists or outside contracts in the development of an Internet home page for the Obed WSR. It should be designed to provide current flow data and information exchange. 2. Develop programs and displays designed to disseminate information on water quality information related to the Obed WSR.
OBRI-N-222	Determine Trends in the Number of Boatable Days	Internal and Inter-agency Data Coordination Continuous Hydrologic Watershed Modeling Recreation	Analysis of information has not yet occurred that would indicate what affects watershed impoundments have on the number of boatable days in the Obed River.	1. Establish criteria for "boatable" days in various portions of the Obed WSR. Particular attention will be given to criteria for gaging stations and trouble spots along the river. 2. Analyze existing stream flow data, against rainfall and impoundment data to determine what factors can be correlated with the number of boatable days. 3. Check annual precipitation to identify long-term hydrologic trends (i.e., stability, increases, and decreases of flows). 4. Using instream flow model, assess effects of currently proposed impoundments and other developments on number of boatable days. Translate into use impacts and economic effects on resource use. 5. Accept natural flows for what they are. Do not create an argument for controlled releases from impoundments.

OBRI-N-201 .000
Priority: 1

Title: Determine Water Rights and Instream Flow Requirements
Funding Status: Funded: 0.0 Unfunded: 0.0

Servicewide Issues: N12 (WATER FLOW)
N13 (WATER RIGHTS)

Cultural Resources Type: C70
RMAP Program Codes: QOl, QO2

Problem Statement

It is possible that existing and potential upstream impoundments of surface water in the Obed River watershed threaten the free-flowing condition of the Wild and Scenic River the National Park Service is mandated to protect. According to the Tennessee Valley Authority, unpublished GIS data, 2515 water impoundments have been constructed in the Obed River watershed between 1976 (the creation of abed WSR) and 1994, with 14 over 50 acre-feet in capacity. Also, several projects for municipal water supply systems have been proposed for future development. These existing and proposed impoundments may alter: the timing of surface runoff, peak flood flows, sediment transport regime, base flows, and the temperature regime of the Streams. There is currently little information available to Obed WSR management that documents the effects of the impoundments on the hydrology of Obed WSR's Streams and rivers.

After the effects of the impoundments on the hydrology is known, a need exists to determine the impacts of any hydrologic alterations to the water-related natural resources and recreational activities that occur within Obed WSR. Since it is presently uncertain what effects, if any, these existing and proposed water development projects have on the hydrologic variables listed above, consequently, there is little information to describe any changes to the natural resources and recreational activities which are dependent on these hydrologic variables. It is possible that the purposes for which Obed WSR was included in the Wild and Scenic River system, as well as mandates for all National Park Service units, may be compromised by these impoundments.

The results of studies mentioned above can be related to water rights for Obed WSR. However, at this time, it is unclear as to the nature and extent of water rights to which Obed WSR is entitled. The Wild and Scenic Rivers Act of 1968 reserves enough unappropriated water necessary to fulfill the purposes designated in the act. There is a question of whether the reserved water rights doctrine applies to an area where there are no lands reserved from the public domain. Obed WSR has no reserved lands. It is also unclear how an instream flow right would be protected by the State of Tennessee, which administers water rights by the riparian water rights doctrine.

Description of Recommended Project or Activity

With the assistance of the National Park Service, Water Resources Division, Water Rights Branch, and the Office of the Solicitor (The Office of the Solicitor will be consulted to provide guidance), undertake activities that will: a) determine the extent of Obed WSR water rights in the Federal and State settings, and b) determine flow needs of water-related natural resources and recreational activities necessary to Obed WSR. Conduct analysis to assess whether the existing impoundments have altered the free-flowing conditions as defined by legislation. The results of these efforts will lead to a better understanding of the flows necessary to fulfill the purposes of the Wild and Scenic River.

OBRI-N-201 .000

Priority: I

The project will include these elements:

1. Obtain legal review and opinion from the Office of the Solicitor concerning the nature and extent of the NPS's rights for Obed WSR.
2. Studies designed to obtain information that will assist the NPS in:
   a.) determining, the effects of existing and future impoundments on the flow of the Obed River and its tributaries
   b.) characterizing water-dependent natural resources found in Obed WSR
   c.) estimating the effects of the impoundments on the water-related natural resources or recreational activities.

OBRI-N-201 .000
Priority: I

BUDGET AND FTEs

—	—FUNDED			
	Source	Activity	Budget ($1 000's)	FTEs
1999:			See Note	
2000:				
2001:				
2002:				
2003:				
		Total:		

—-----UNFUNDED —				
	Source	Activity	Budget (1 000's)	FTEs
1999:	WATER-RES		See Note	
2000:				
2001:				
2002:				
2003:				
		Total		

Compliance codes:

Explanation:

End of data

Note: Funding and FTEs for this project will be provided from the water-rights funds of the NPS and will vary depending on the scope of information gathering activities, the priority of this project as compared to other NPS projects dealing with water rights, and the availability of funds. Therefore, a budget and estimate of FTE's are not available at this time.

Alternative Actions/Solutions and Impacts

No Action: Existing and future water development projects may affect the ability of NPS to accomplish its mission if it cannot determine flow requirements. The NPS would not have adequate information on which to support water rights for Obed WSR. Without adequate information, NPS would be unable to prove injury or loss of park resources and rights before actions could be taken to protect them.
OBRI-N-202.000

Priority: 2

Title: Support USGS NAWQA Monitoring Program and Activities
Funding Status: Funded: 0.0 Unfunded: 77.5

Servicewide Issues: N20 (BASELINE DATA)

Cultural Resource Type: C70

RMAP Program Codes: QOI

Problem Statement

Stream flows are determined by rainfall and runoff patterns, groundwater recharge, and flow alterations occurring in the watershed. Like other streams on the plateau, the Obed River and its tributaries have their highest flows during the winter and spring. Low flow periods normally occur in summer and early autumn, when upper reaches of the river system resemble intermittent streams in which pools form with little or no flow between them. Topography of the region, with its deep gorges, facilitates wide ranges and rapid changes in flow. Presently, only one gaging station, installed in March of 1997 on Clear Creek at Lilly Bridge, is located within the National Park Service Unit to monitor water quantity. Ten water quality, monitoring sites within the Obed WSR boundaries have been established by the NPS. These sites are designed to monitor various water quality parameters, including: pH, conductivity, acidity, alkalinity, dissolved oxygen, manganese, sulfates, iron, temperature, hardness, and bacteria.

An opportunity to significantly enhance the available water resources information base has occurred. The NPS is engaged in efforts to coordinate with the USGS National Water Quality Assessment (NAWQA) Program to address NPS water issues. The USGS has chosen the Obed River as one of 59 national study units partially because of the strong relationship between the Obed WSR National Park Service Unit, USGS, TVA, TDEC, and TWRA. The USGS NAWQA Unit began monitoring water quality, on a monthly basis, at Lilly Bridge on Clear Creek during the summer of 1996. Some of the water quality parameters used by USGS include: temperature, pH, conductivity, and dissolved oxygen are determined in the field. Iron, sulfate, manganese, turbidity, chloride, hardness, acidity, alkalinity, total and fecal coliform and fecal strep. In March of 1997 the Unit installed a flow gage on Clear Creek at Lilly Bridge and will operate it for a minimum of two years. The Unit samples a total of 95 different parameters in the Obed River Watershed thereby producing one of the most thorough water resource databases available to the National Park Service Unit management to date.

The objectives of the “pilot” NPS-NAWQA collaborative program are to (1) establish a strong cooperative partnership with a national, institutional water quality program (2) influence monitoring decisions that result in products that address park specific water quality issues; and (3) demonstrate the efficiency and effectiveness of NPS-NAWQA collaborations to support future budget initiatives that would permit full implementation of this agreement to meet highpriority water quality monitoring needs in parks. In addition, the program represents a partnership at the Department level which can provide support to the NPS inventory and monitoring program.

Description of Recommended Project or Activity

The main objective of this project is to support the USGS NAWQA Unit monitoring efforts in the region which directly or indirectly complement the NPS program. Other objectives include

establishing cooperative partnerships with a national, institutional water quality program, influencing monitoring decisions that result in products that address Obed WSR specific water quality issues, and demonstrating the efficiency and effectiveness of NPS-NAWQA collaborations to support future budget initiative that would permit implementation of the cooperative agreement on a national basis to meet high-priority water quality needs in parks.

The project will include these elements:

1. Provide data and staff support, as needed, to USGS NAWQA Program.
2. Participate in inter-agency coordination meetings to share data and findings from study sites.
3. Obtain data gathered from study and input into baseline database (GIS)
4. Utilize NAWQA data to assess potential water resource problems.

OBRI-N-202.000
Priority: 2

BUDGET AND FTEs

—--------FUNDED--~---—-- —

Source	Activity	Budget ($1 000's)	FTEs
1999:			
2000:			
2001:			
2002:			
2003:			
	Total:		

———-UNFUNDED

Source	Activity	Budget (1000's)	FTE5
1999:		15.5	0.03
2000:		15.5	0.03
2001:		15.5	0.03
2002:		15.5	0.03
2003:		15.5	0.03
	Total	77.5	0.15

Compliance codes:
Explanation:
End of data

OBRI-N-203.000
Priority: 3

Title: Assess Adequacy of Existing Water Quality Data and Manage and Update Incoming Data
Funding Status: Funded: 42.0 Unfunded: 101.0

Servicewide Issues: Ni 1 (WATER QUAL-EXT)
N20 (BASELINE DATA)

Cultural Resource Type: C70

RMAP Program Codes: QOl, C03

Problem Statement

The development of a numeric baseline of water quality conditions is a necessary precursor to an Outstanding National Resource Waters designation by the State and to enable the Obed WSR to meet its mandate of preserving its resources. Tasks 1, 1 a, I b, and I c (as outlined in the Description of Recommended Project or Activity section) specifically provide data to support ONRW standards.

Historic through present day external source, water quality data for the Obed/Emory watershed has not been consolidated into one database. However, efforts are currently underway by the NPS to assemble existing data into a STORET-compatible format. Without this information complied into a single database, it may be difficult to identify current and future trends in the Obed WSR water resources and demonstrate a need for the ONRW designation.

Historical water quality data for the Obed River watershed has shown that the primary impacts upon the Obed Wild and Scenic River and its tributaries have been from agricultural and/or forestry practices (i.e., plantations) from areas outside the Obed WSR boundaries (Rikard 1985). Therefore, comprehensive water quality studies and monitoring should include areas in the watershed beyond the Obed River, Clear Creek, and Daddys Creek (Spradlin 1993). Another, and possibly more severe impact, can be produced by acid mine drainage from coal mining in the watershed (Rikard 1985). Current data has also shown an increasing influence from urban development in the upper reaches of the Obed River in and around the city of Crossville, TN (Wojtowicz and Clark 1989; TDEC 1994). Water quality monitoring allows for a thorough assessment of the level of effects from these impacts and adequate management and protection of Obed WSR resources.

Ten water quality monitoring sites within the Obed WSR boundaries have been established by the NPS and currently monitor pH, conductivity, acidity, alkalinity, dissolved oxygen, manganese, sulfates, iron, temperature, hardness, and bacteria. One permanent gaging station (located on Clear Creek at Lilly Bridge) is located in the National Park Service Unit. As development and land use increases around the boundary, cumulative impacts will occur without

recognition or proper mitigation, because these water quality parameters suffice as indicators of certain impacts, themselves fail to identify all activities in the watershed impacting water quality in the Obed WSR. For example, impacts from agricultural practices in the Obed/Emory watershed are not fully identified by these parameters. Row crop farming has lead to the introduction of chemical pollution from pesticides and herbicides, and nutrient enrichment has resulted from cattle grazing.

Obed River. On the Obed River proper, the primary impacts are from the city of Crossville, Tennessee and the surrounding area. Most of these impacts can be related to the increased levels of urban development taking place in this region. The source of particular interest in the

past has been the Crossville STP. As mentioned, effluent from this plant is regularly tested for toxicity directly below the discharge using standard methods (Eckenfelder 1991 a, 1991 b, 1991 c). Results from these tests showed some mortality of Ceriodaphnia dubia and some effects on the growth of fathead minnows. Earlier studies of the reach below the STP indicated that the rivers condition was in an unhealthy state, but was comparable to the reach above the SIP (Melgaard and McKinney 1979; Sulkin 1988). These studies indicated that although the SIP was having a negative influence on the river the most significant impact was occurring upstream of the plant. Sources of impact responsible were considered to be urban runoff/erosion, the water plant backwash water, and low flow effects from Lake Holiday (Sulkin 1988). Results from later studies have indicated similar conditions still exist above the SIP and are increasing due to more urban development (Wojtowicz and Clark 1989; Pennington and Associates 1994). Current state classifications show that the portion of the Obed River that flows through Crossville is designated as "partially supporting" of its designated uses due to organic enrichment, low dissolved oxygen, nutrients, siltation, and flow alteration, resulting from municipal point sources, land development, and dam construction (TDEC 1994). At the point where the Obed River flows into the National Park Service Unit boundaries, the effects of dilution from tributaries have improved the water quality to the point where the river is designated "fully supporting."

Clear Creek. Clear Creek has shown little evidence of impacts. Slightly elevated levels of conductivity, fecal coliform, and fecal streptococcus indicate some impacts from agricultural practices and potentially human disposal systems (septic systems, SIP) (Rikard 1985; Spradlin 1993). Recent detection of the pesticide Atrazine, in trace amounts, indicates impacts from agriculture as well (Treece, USGS, personal communication). Trace levels of sulfates were also detected, which may indicate some minor runoff from coal mining activities (Rikard 1985). However, sulfates can also be produced by mere disturbance of certain minerals in the watershed (Julian, WA, personal communication).

Other Tributaries. Of the many tributaries into the Obed Wild and Scenic River, four have been the subject of past or present monitoring. These are: White Creek (flows into Clear Creek), Daddys Creek and Otter Creek, (flow directly into the Obed River), the Emory River (the Obed River flows into it at the lower end of the Obed WSR boundaries), and Rock Creek which flows into the Emory River before it enters the Obed WSR boundaries (Rikard 1988; Spradlin
1993).

Both White Creek and Daddys Creek have experienced slightly elevated levels of conductivity and hardness, indicating some impacts from agricultural and/or forestry practices (Rikard 1988). More current data has shown that these conditions persist but have not worsened (Spradlin 1993). Otter Creek has experienced some degradation due to the exposure of coal seams and the location, construction, and operation of Dartmoore Lake (Bakaletz, NPS, personal communication).

One of the most heavily degraded tributaries in the system is Rock Creek. The effects of acid mine drainage have made this stream almost unsuitable for aquatic life (Rikard 1988). Recent data suggest that conditions have changed little (Spradlin 1993).

Beginning in January of 1997, the IDEC began conducting water quality sampling on the Obed/Emory watershed for a period of two years as part of a statewide, two year rotational, watershed sampling program (Stodola, IDEC, personal communication). The IDEC has selected three water quality, sampling stations for the Obed/Emory watershed (Cartwright, TDEC, personal communication). One of the stations is located at Potter Ford on the Obed River and is sampled bimonthly. Another station is located on the Emory River at Oakdale and is sampled bimonthly. The last station is an "ecoregion" station (i.e., considered to be typical for

the ecoregion in terms of physiography, gradient, etc.) and is located on Clear Creek at Jett Bridge (Highway 298). This station is sampled quarterly. IDEC has no plans for future water quality monitoring stations (Stodola, IDEC, personal communication).

Seven NPDES permits designed to limit the amount and type of effluents discharged into Obed River watershed have been issued by the TDEC (Table 7). These permits are all related to municipal and industrial effluents (Smith, IDEC, personal communication).

The City of Crossville has two designated water quality monitoring stations and has no plans for any future sites (Annis, Crossville Wastewater Treatment Facility, personal communication). The designated stations are located one and two miles below the city's sewage treatment plant (SIP). With recent improvements in the aquatic communities (as documented by Wendel Pennington Associates, Inc.) and enlargement of plant facilities, the Plant's NPDES permit no longer requires instream biological and chemical testing at these stations unless an impact is suspected (Annis, Crossville Wastewater Treatment Facility, personal communication; Stodola, IDEC, personal communication). However, the SIP's NPDES permit does require water chemistry monitoring directly below the plant's discharge on a daily basis.

Description of Recommended Prolect or Activity

The objectives of this project are to consolidate multi-agency water quality databases, manage and update incoming water quality data, and store consolidated water quality database in a format easily accessible by other agencies. Tasks 2, 3 and 5 support ongoing efforts to assemble existing data for parks across the nation. Task I, I a, I b, and 1 c support Project Statement OBRI-N-205 efforts to attain ONRW designation.

The project will include these elements:

1. Develop numeric baseline of water quality conditions in support of ONRW designation. Necessary research to support ONRW standards includes:
   a) Conduct preliminary analyses on the Obed WSR's historical water quality data to determine if it is sufficient to characterize the ambient water quality conditions, during the designated baseline period, for specific areas of the Obed WSR. This must include key parameters, and represent natural spatial and seasonal variability.
   b) Where the database is inadequate for the baseline year, identify an alternative period that, based on continuity of land and water use patterns and the available data record, is representative of ambient water quality during the baseline period.
   c) Employ appropriate statistical techniques to derive confidence interval estimates for the data. A confidence level of 0.95 or greater should be used, if possible.
2. Assemble data available from the Obed WSR and from external sources.
3. Obed WSR staff should work to insure that the task of entering Obed data into a SIORET-compatible format is completed by the NPS as expeditiously as possible.
4. Develop long-term monitoring strategy and protocols for data management and for water quality/quantity information collected from all sources.
5. Incorporate water quality data collected from external sources into the Obed WSR's water stage database/GIS.
6. Develop and implement procedures for the exchange of water quality data from the various external sources on a scheduled frequency.
7. Use the results of the assessment to supplement the data collected from Long-term Hydrologic Inventory and Monitoring.

OBRI-N-203.000
Priority: 3
Literature Cited

Annis, Clark. 1997. Superintendent, Crossville, Tennessee Wastewater Treatment Facility. Personal Communication.

Bakaletz, Steve. 1997. National Park Service, Big South Fork National River and Recreation Area. Personal Communication.

Cartwright, Lina. 1997. Tennessee Department of Environment and Conservation. Personal Communication.

Eckenfelder Inc. I99Ia. Report of Toxicity Screening lest Results. Prepared for Crossville Wastewater Treatment Facility, Crossville, Tennessee.

_____ 1991 b. Report of Toxicity Screening lest Results. Prepared for: Crossville Wastewater Treatment Facility, Crossville, Tennessee.

_____ 1991 c. Report of Toxicity Screening Test Results. Prepared for Crossville Wastewater Treatment Facility, Crossville, Tennessee.

Julian, Hank E. 1996. "Groundwater Availability in Cumberland and Fentress Counties, Tennessee," WA Engineering Laboratory Report.

Melgaard, David and David McKinney. 1979. Biological Inventory and Assessment, Obed River, Mile 20.8 to 38.6, Cumberland County. Tennessee Department of Public Health, Division of Water Quality Control, Nashville, Tennessee.

Pennington and Associates, Inc. 1991. Biological Survey Obed River. Prepared for City of Crossville, Tennessee.

Rikard, Michael. 1985. Obed Wild and Scenic River Water Quality Report. U.S. Department of Interior, National Park Service, Obed Wild and Scenic River, Wartburg, Tennessee.

Smith, Woody. 1997. NPDES Permits. Tennessee Department Of Environment and Conservation, Knoxville. Personal Communication.

Spradlin, Etta. 1993. Memorandum: Obed Water Quality Summary. U.S. Department of Interior, National Park Service, Obed Wild and Scenic River, Wartburg, Tennessee.

Stodola, Paul. 1997. Tennessee Department of Environment and Conversation, Water Pollution Control Division. Personal Communication.

Sulkin, Barry W. 1988. Assimilative Capacity Study of the Obed River at Crossville, Tennessee. Tennessee Department of Health and Environment, Division of Water Pollution Control, Nashville, Tennessee.

Tennessee Department of Environment and Conservation. 1994. The Status of Water Quality in Tennessee 1994 305(b) Report. Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Nashville, Tennessee.

Ireece, Rick. 1996. Water Quality Specialist, U.S. Geological Survey. Personal Communication.

OBRI-N-203.000
Priority: 3

Wojtowicz, John and Byron F. Clark. 1989. An Intensive Survey of the Obed River, Cumberland County, Tennessee 1988. Tennessee Department of Health and Environment, Division of Water Pollution Control, Nashville, Tennessee.

OBRI-N-203.000
Priority: 3

BUDGET AND FTEs

———-FUNDED

Source	Activity	Budget ($1 000's)	FIEs
1999:		12.0	0.2
2000:		12.0	0.2
2001:		6.0	0.1
2002:		6.0	0.1
2003:		6.0	0.1
	Total:	42.0	0.7

UNFUNDED —Source Activity Budget (1000's) FIEs

1999: 18.0 0.3

2000: 38.0 0.2

2001: 33.0 0.2

2002: 6.0 0.1

2003: 6.0 0.1 Total 101.0 0.9

Compliance codes:

Explanation:

End of data

OBRI-N-204.000
Priority: 4

Title: Establish Long-term Water Quality Inventory and Monitoring Program Using Chemical, Biological, and Physical Parameters.

Funding Status: Funded: 30.0 Unfunded: 14.0

Servicewide Issues: Ni i (WATER QUAL-EXT)
N20 (BASELINE DATA)

Cultural Resource Type: C70

RMAP Program Codes: QOi, C03

Problem Statement

Due to impacts associated with increasing development, small scale forestry operations, as well as agriculture, oil and gas exploration, etc., and the effect they can have on water quality and the associated dangers posed recreationalists, water quality monitoring is essential to the Obed WSR. Maintaining a water quality monitoring program adequate to protect Obed WSR resources, will require expansion of the current efforts, periodic evaluation, and coordination with other federal, state, and local agencies with water management responsibilities. Evaluation of the water quality program will include assessment of the adequacy of the existing sampling network and water quality parameters to capture events and trends important to protection and maintenance of the integrity of water resources managed by the National Park Service Unit.

With ongoing perturbations in the Obed/Emory watershed (e.g., sedimentation, nutrient enrichment, low flows, etc.), long-term chemical, biological and physical (i.e., vital signs) monitoring is of paramount importance in order to monitor the impact to water quality, fisheries and aquatic biological resources due to both natural and human-induced activities occurring inside the Obed WSR boundaries and from sources upstream. And in a related matter, it is an excellent means by which the NPS can monitor how well the Obed WSR meets and maintains the water quality requirements for ONRW designation.

The Obed WSR National Park Service Unit has monitored water quality at ten stations within its boundaries since 1982. The rationale that many state and federal agencies use for emphasizing chemical monitoring is that chemical criteria, developed through toxicological studies of standard aquatic organisms, serves as surrogate measures for monitoring biological integrity (Miller et al. 1988). However, this chemical monitoring alone was not intended to take into account the naturally occurring geographic variation of contaminants, consider the synergistic effects of numerous contaminants, nor consider the sublethal effects (e.g., reproduction, growth) of most contaminants (Karr 1981). Therefore, this approach does not directly measure the ecological integrity of surface waters. As a consequence, changes in other factors such as physical habitat are often limiting and can lead to the decline of biological communities (Karr and Dudley 1981). In such cases, ecological integrity is unlikely to be improved by controlling chemical pollution (Miller et al. 1988) alone.

The direct monitoring of the “healthy” biological communities is sensitive to changes across a wide array of environmental factors because it has the ability to integrate the effects of many man-induced perturbations such as flow alterations and stream habitat and watershed degradation (Karr 1981; Karr et al. 1986). Biological communities (particularly benthic macroinvertebrates) are also sensitive to low-level disturbances that chemical monitoring may not detect (Chandler 1970). According to the Ohio Environmental Protection Agency (1988), which has adopted bioassessment as part of its water quality monitoring program, numerous attributes of biological communities make them particularly well-suited to define environmental degradation. The structural and physical characteristics of fish and benthic macroinvertebrate

communities are considered to be relative to physical and chemical aquatic environmental conditions. They can be utilized to identify likely causes of any recognizable perturbation of the aquatic biological communities.

Assessment of physical habitat (i.e., instream habitat capable of supporting aquatic life, root wads, etc.) must also play a supporting role with chemical and biological inventory and monitoring. It is used to identify obvious constraints on the attainable potential of the site, help in the selection of appropriate sampling stations, and provide basic information for interpreting biological inventory results. Both the quality and quantity of available physical habitat affect the structure and composition of resident biological communities and their potential as well (Plafkin et at. 1989). The importance of holistic habitat assessment to enhance the interpretation of biological data can be very important (Ptafkin et at. 1989). Where physical habitat quality is similar, detected impacts can be attributed to particular water quality characteristics related to specific human activities in the watershed.

The WA and USGS have entered into a cooperative arrangement to develop a long-term biological monitoring program for the Obed/Emory watershed (typically in the lower stream reaches). WA identified four fixed sites within the Obed WSR boundaries and began sampling them in 1996. Selection of sampling sites was based on two criteria: ratio of discernible habitat types (riffle, run, and pool) present and suitability for assessment of the cumulative effects of pollutants entering the watershed. Sites were selected that included an acceptable ratio of habitat types characteristic of the subject stream. Fish surveys in the creeks and the Obed River consist of qualitative and/or quantitative collections analyzed using the index of biotic integrity (lBl) (Kan- et at. 1986). The IBI is an assessment of environmental quality at a stream site through application of ecologically-based metrics to fish community data. Streams also receive an ecological classification based on diversity of intolerant families (mayflies, stoneflies, and caddisflies - EPI) and abundance of tolerant organisms. In 1997, the USGS added an additional site at Alley Ford. This station wilt be monitored on an annual basis for three years intensively. At this time, the USGS is uncertain whether or not the station will continue to be sampled after the three year period (Ahlstedt, USGS, personal communication).

The existing water quality monitoring network in the Obed WSR currently meets minimal requirements. With ongoing perturbations (sedimentation, nutrient enrichment, low flows, etc.) in the Obed/Emory watershed, long-term chemical, biological, and physical monitoring is important not only to current management needs for Obed WSR resources, but to protect the water quality and biological communities found in the system.

Description of Recommended Proiect or Activity

The objective of this project is to use water quality inventory and monitoring (using chemical, biological, and physical parameters) to aide in the improvement of water quality and biological communities found in the system.

The project will include these elements:

1. Implement strategy developed in Project Statement OBRI-N-203.
2. Inventory fish and benthic macroinvertebrate communities in order to detect and monitor of changes in biological diversity, species composition, and relative abundance of aquatic organisms in response to natural causes (e.g., floods, droughts, etc.) and human-induced events (e.g., previous grazing, prescribed natural fires, and other land-use activities). Monitoring would continue as a cooperative effort of NPS, USGS, WA, and IDEC for a period of three to five years at which time it could be reduced to semi-annually.

OBRI-N-204.000
Priority: 4

3. Coordinate inventory and monitoring of chemical, biological, and physical parameters, within the Obed WSR Park Service Unit, with federal, state, and local agencies.
4. Establish a database over a period of three to five years.
5. Analyze and attempt to determine the cause of impacts.

OBRI-N-204.000
Priority: 4

BUDGET AND FTE5

— FUNDED

	Source	Activity	Budget ($1 000's)	FTE5
1999:			6.0	0.1*
2000:			6.0	0.1*
2001:			6.0	0.1*
2002:			6.0	0.1*
2003:			6.0	0.1*
		Total:	30.0	0.5*

* Currently provided through biotech.Support from Big South Fork NRRA

———UNFUNDED

	Source	Activity	Budget (1000's)	FTEs
1999:			6.0	0.1
2000:			2.0	0.03
2001:			2.0	0.03
2002:			2.0	0.03
2003:			2.0	0.03
		Total	14.0	0.22

Compliance codes:
Explanation:
End of data

OBRI-N-205.000

Priority: 5

Title: Outstanding National Resource Waters Designation
Funding Status: Funded: 0.0 Unfunded: 65.0

Servicewide Issues: NI I (WATER QUAL-EXT)
N13 (WATER RIGHTS)

Cultural Resource Type: C70
RMAP Program Codes: QOI, Q02, C03

Problem Statement

Water resources and ripanan environments are principal resources of the Obed WSR. The water is considered to be among the highest quality in the State of Tennessee supporting a rich ecological diversity. However, activities occurring outside the Obed WSR Park Service Unit influence the waters within its boundaries. These activities include: coal mining, oil and gas exploration, quarrying, sewage discharge, agriculture and forestry practices, some residential development, garbage disposal and construction of numerous water supply ponds and impoundments on tributaries of the Obed and Emory rivers.

The State of Tennessee Water Quality Standards, part of the Water Quality Control Act, describe the reasonable and necessary uses of water within the State that are deemed to be in the public interest. Designated uses for the Obed/Emory watershed include: sources of water supply for domestic and industrial purposes, propagation and maintenance of fish and other aquatic life; recreation in and on the waters including the safe consumption of fish and shell fish; livestock watering and irrigation; propagation and maintenance of wildlife. However, these designated uses afford the waters of the Obed WSR only limited protection. As a result, activities outside the boundaries of the Obed WSR allow for a certain degree of degradation to continue.

Historical water quality data for the Obed River watershed has shown that the Obed Wild and Scenic River and its tributaries have been primarily impacted from agricultural and/or forestry practices (i.e., plantations) in the area (Rikard 1985). A second, but possibly more severe impact, can be produced by acid mine drainage from coal mining in the watershed (Rikard 1985). Current data has shown that although the most significant impacts are still from agricultural and/or forestry practices, there is increasing influence from urban development in the upper reaches of the Obed River in and around the city of Crossville, TN (Wojtowicz and Clark 1989;
TDEC 1994).

Seven NPDES permits designed to limit the amount and type of effluents discharged into Obed River watershed have been issued by the TDEC (Table 7). These permits are all related to municipal and industrial effluents and limit the amount of waste-load discharges based on computer simulation models (Smith, TDEC, personal communication).

The Wild and Scenic Rivers Act offers a certain degree of protection to the Obed WSR in terms of preserving its free-flowing condition and protecting the immediate environment for the benefit and enjoyment of future generations. State Protected Water Uses allow discharges that degrade water quality so long as the quality remains sufficient to support the designated uses. However, designation of a stream as an Outstanding National Resource Waters Designation is designed to protect and maintain existing high water quality by prohibiting discharges and alteration that degrade water quality from that which currently exists.

OBRI-N-205.000
Priority: 5

Tennessee's Water Quality Standards are designed to fully protect existing uses of high quality surface waters as established under the Water Quality Control Act. Characteristics of high quality waters include: (a) waters designated by the Water Quality Control Board as Outstanding National Resource Waters (ONRWs) in accordance with Section i200-4-3-.06(3); (b) Waters that provide habitat for ecologically significant populations of aquatic or semi-aquatic plants or animals, including those identified on State of Tennessee or U.S. Fish & Wildlife Service lists of rare, threatened, or endangered species; (c) Waters that provide specialized recreational opportunities related to existing water quality; (d) Waters that possess outstanding scenic or geologic values; (e) waters where existing conditions are better than water quality standards.

Waters of the State receiving the ONRW5 designation by the Water Quality Control Board are considered to be high quality waters which constitute an outstanding national resource, such as waters of national and state parks and wildlife refuges, and waters of exceptional recreational or ecological significance. The designation of the Obed WSR as a ONRW would afford it the most stringent designation available under the Clean Water Act.

Description of Recommended Proiect or Activity

The objective of this project is to pursue the ONRW designation through the State of Tennessee's regulatory process. Implementation of tasks 2, 3, and 4 as well as Project Statements OBRI-N-203 and OBRI-N-206 will be necessary to provide a quantitative baseline of water quality conditions as required by statute for the implementation and monitoring for the non-degradation standards. Designation of ONRWs in the State of Tennessee must be made by the Water Quality Control Board and is accomplished in accordance with Section 69-3-105(a) (1) of the Tennessee Water Quality Control Act and through the appropriate rule-making process. Existing water quality is the criteria in these waters. Existing discharges, including existing upstream discharges are allowed at present levels.

The project will include these elements:

1. Work to ensure that the Obed WSR National Park Service Unit is on the state's mailing list for notification of dates and locations for its triennial review for special water designations.
2. Preparation of a formal request for redesig nation, and submission to the TDEC.
3. Participate in the state's triennial review process for special water designations.
4. Provide support to the state in their analysis of benefits and costs of an ONRW designation.
5. Coordinate with, and where necessary provide testimony to, the state Water Quality Control Board.

OBRI-N-205.000
Priority: 5

BUDGET AND FTEs

———— —--FUNDED—----———————-

	Source	Activity	Budget ($1 000's)	FTEs
1999:				
2000:				
2001:				
2002:				
2003:				
		Total:		

————————-UNFUNDED

	Source	Activity	Budget (1000's)	FTEs
1999:			32.5	0.5
2000:			32.5	0.5
2001:				
2002:				
2003:				
		Total	65.0	1.0

Compliance codes:
Explanation:
End of data

OBRI-N-206.000
Priority: 6

Title: Develop Inter-agency Data Coordination
Funding Status: Funded: 0.0 Unfunded: 55.0

Servicewide Issues: N 20 (BASELINE DATA)

Cultural Resource Type: N/A

RMAP Program Codes: QOl, CO3

Problem Statement

The Obed WSR constitutes about 1.5 percent of the watershed. The National Park Service Unit is situated approximately in the lower half of the Obed on the middle third of the Emory River drainage. The high degree of hydrologic interdependence of the Obed WSR and other portions of the watershed, makes data coordination with other stakeholders critical for effective management of water resources. -

As a major stakeholder in the watershed, it is in the best interest of the Obed WSR to cooperate in the gathering and coordination of water resources data. Several agencies, businesses and utilities, other than the NPS address water quality and water resource issues in the Obed/Emory watershed. Six agencies (IVA, USGS, USFWS, NRCS, IDEC, and TWRA) are currently conducting various types of data collection (hydrological, biological, water chemistry, etc.). However, the hydrologic and ecological databases are not in a compatible format between some of the cooperating agencies and are not accessible to all agencies. For example, effective participation in the state's permitting process is important to protection of Obed WSR water resources. The participation may include providing quantitative, fact-based comments, permit approval or denial or requested monitoring recommendations, and mitigation activities.

Opportunities for data coordination are numerous. For example, the USGS National Water Quality Assessment (NAWQA) Program has chosen the Obed River as one of it's 59 national study units, and will be collecting detailed streamfiow and water quality data. WA's Ft. Loudon/Melton Hill/Watts Bar River Action Team (RAT) conducts water quality and biological monitoring of water resources in the Obed/Emory watershed, implements water resource improvement projects, and works to build inter-agency and community support for water quality improvement activities and enhance resource protection. NPS coordination with TDEC to obtain monitoring data, information regarding permitting activities in the watershed, and other water resource protection efforts is an important step to implementing objectives of the WRMP. Other agencies, such as the NRCS, also conduct water resource-related activities in the Obed/Emory watershed. A stronger working relationship between the NPS and NRCS is important, especially with regards to promoting agricultural BMP5 to reduce the impact of livestock and farming activities on water quality.

With federal, state, and local agencies involved in research and monitoring programs within the Obed/Emory watershed, coordinating the collection of data as well as managing historical data will promote a more thorough knowledge of the watershed, prevent redundancy in sampling, and produce a more thorough database which wilt assist in acquiring the ORNW designation by the state. Substantial inter-agency coordination wilt also be required to make data sets compatible with NPS needs and those of other agencies collecting hydrological or water quality data in the Obed/Emory waters. With the number of agencies involved in various aspects of water quality sampling in the Obed/Emory Watershed, a wealth of information is becoming available. These data sets need to be assembled into one database in format easily accessible by all external sources.

OBRI-N-206.000
Priority: 6

Description of Recommended Protect or Activity

The objective of this project is to improve upon data management systems for the acquisition, storage, and retrieval of data and information in a timely and readily-accessible format for internal use and for acquisition by other users (including the public) and use this data when making an application to the State of Tennessee's Water Quality Control Board for the ONRW designation.

The project wilt include these elements:

I. NPS should participate in the coordination of data collection and management between WA, USGS, NRCS, USFWS, TWRA, IDEC, and local utilities to maximize efficiency.
2. Obed WSR staff enter NPS water quality data into the EPA's STORET database so it can be summarized in their Baseline Water Quality Data Inventory and Analysis Reports and permanently archived for use by states and other parties interested in Obed WSR water quality.
3. Develop protocols for data collection and analysis so data sharing can take place. Produce a semi-annual report in order to encourage timely gathering and analysis of NPS data, and also put it in a form that is useful for the superintendent and other agencies.

OBRI-N-206.000
Priority: 6
BUDGET AND FIEs

—–—–— FUNDED-———————

	Source	Activity	Budget ($1 000's)	FTE5
1999:				
2000:				
2001:				
2002:				
2003:				
		Total:		

—UNFUNDED———

	Source	Activity	Budget (100(Ys)	FTE5
1999:			11.0	0.1
2000:			11.0	0.1
2001:			11.0	0.1
2002:			11.0	0.1
2003:			11.0	0.1
		Total	55.0	0.5

Compliance codes:
Explanation:
End of data

OBRI-N-207.000

Priority: 7

Title: Develop Education and Interpretative Programs for Water Resources
Funding Status: Funded: 0.0 Unfunded: 78.0

Servicewide Issues: 100 (INTERPRETATION OF NATURAL RESOURCE ISSUES)

Cultural Resource Type: N/A

RMAP Program Codes: QOl

Problem Statement

Educating In preparation for the Obed WSR WRMP, a public scoping meeting was neic on December 12, 1995. Education and communication was a preeminent need identified by the public meeting participants. The need for additional information on topics such as water quality, water quantity, adjacent land uses, private property rights, coalitions, recreation, preservation of cultural resources, government regulations, NPS policies, water rights, and Obed WSR boundaries and easements was identified in the meeting. Presently, there are no educational/interpretive programs designed to address these information needs.

An important element to the success of the Obed WSR National Park Service Unit resource management activities is the development of well-thought out, and publicly reviewed action plans, such as this WRMP. The educational/interpretive programs developed by the NPS and, in conjunction with WA and others, should be tied to meeting information needs of park visitors (including recreationalists), adjacent landowners (especially those upstream of the Obed WSR), and school and concerned citizen groups. These information needs include water resource management problems in the Obed/Ernory watershed such as private property rights, how resource issues are prioritized, and impacts to the Obed WSR as a result of development, agricultural practices, and oil and gas exploration in the watershed. However controversial resource management decisions to deal with these problems may seem, the NPS needs to demonstrate through educational/interpretive programs that they are based on sound research and designed to protect resources now and into the future. These programs should be an integral part of the resource management function of the abed WSR National Park Service Unit.

High priority should be given to the development of educational/interpretive programs dealing with the value of a preserved river system and the cooperative work between the NPS (on the part of the Obed WSR National Park Service Unit) and other agencies to support monitoring efforts ongoing in the region which directly or indirectly complement the NPS program to insure that the Obed WSR is preserved. Examples of mutually-beneficial cooperation are the current efforts of the USGS NAWQA Unit (as mentioned), WA's Ft. Loudoun/Melton Hill/Watts Bar watershed RAT, TDEC, and NRCS. Additional, enhanced participation in commenting and requesting avoidance alterations or mitigation from state-permitted activities should follow from greater awareness of existing resources and activities.

Meeting the information needs of adjacent local governments, industries, citizen groups and adjacent landowners will serve to gain support for Obed WSR programs. Because of degradation of both water quantity and quality in the Obed WSR from activities outside the National Park Syervice Unit, the Park Service's mission can only be successful with informed public and stakeholder watershed support. Informing these groups and organizations via educational/interpretive programs will not only gain needed support for the National Park Service Unit's programs, but hopefully, provide informed participants the opportunity to work with the NPS in protecting the natural resources of the abed WSR and insuring.

OBRI-N-207.000

Priority: 7

Description of Recomrnended Project or Activity

The main objective of this project is to gain support for Obed WSR programs. Other objectives include providing an informed public the opportunity to participate in protecting the natural resources of the Obed WSR, insuring that educational/interpretive programs are a component of all abed WSR resource projects and programs (including participation in general management and resource management planning, and in preparation of statements for management), encourage coalitions through educational/interpretive programs, and research the availability of grants from the state, the National Park Foundation, EPA, etc. to assist with funds in these endeavors.

The project will include these elements:

1. Develop programs and displays designed to disseminate information on NPS policies and programs.
2. Programs tied to the water resource management problems associated with water resource issues in the abed/Emory watershed such as development, agricultural practices, and oil and gas exploration.
3. Coordination at both management and technical levels with state, local and federal agencies and watershed user groups.

OBRI-N-207.000
Priority: 7

BUDGET AND FTE5

—--------— FUNDED———-———

Source	Activity	Budget ($1 000's)	FTE5
1999:			
2000:			
2001:			
2002:			
2003:			
	Total:		

—--UNFUNDED———-—

Source	Activity	Budget (1000's)	FTEs
1999:		18.0	0.3
2000:		26.0	0.3
2001:		34.0	0.3
2002:			
2003:			
	Total	78.0	0.9

Compliance codes:
Explanation:
End of data

OBRI-N-208.000
Priority: 8

Title: Develop Long-term Coordination/Coalition Building
Funding Status: Funded: 0.0 Unfunded: 30.0

Servicewide Issues: N10 (MINRL/GEOTHERM) N12 (WATER FLOW) NI I (WATER QUAL-EXT) NI6 (NEAR-PARK DEV)

Cultural Resource Type: C70, C73

RMAP Program Codes: QOI

Problem Statement
The local community surrounding the abed WSR is rapidly growing. Large subdivisions are being developed within the abed River watershed, and the population in the area is expected to increase. The population in Cumberland County alone has grown by 13 percent from 1990-I 995, and growth is expected to continue based on current trends. The population growth will undoubtedly spur the development of business enterprises such as shopping malls and fast-food restaurants in the abed watershed. The Obed WSR's well-being is closely intertwined with that of its neighbors since the authorized land of the Obed WSR makes up only a small, mid-basin portion of the Obed River watershed. To provide protection it is necessary for managers to have information on the potential effects of development to the abed WSR's water resources and to disseminate this information to concerned parties (i.e., adjacent landowners, park visitors, etc.).

In addition to population growth and the resulting residential construction, a wide array of land management practices on public and private lands occur upstream of the Obed WSR. Lands within and adjacent to the boundaries have been leased for the extraction of coal, oil and gas. Clearing lands for development, oil and gas drilling, and agricultural and residential land activities can irnpact water quality by causing soil erosion, ground and surface water pollution, and drainage alteration.

Various regulatory issues need to be considered when addressing long-term protection of water resources of the abed WSR. Land use planning, zoning regulations, stormwater management guidelines, erosion control for development and roads, and stream-side buffer zone protection all have the potential to protect, preserve, and in some cases improve water resource conditions in the Obed/Ernory watershed. State and local governrnents, county planning commissions, industrial boards, economic development agencies, and various other entities deal with these issues. There is a need to cornrnunicate to these agencies the importance of preserving the integrity of the Obed WSR, and to implement voluntary incentives to reduce the irnpact of non-point source pollution from increased land use conversion and resource extraction activities. It is unlikely, given econornic and political considerations, that additional regulations will be enacted. Voluntary incentives and public education, however, are likely overtime to rnake an impact on reducing the impact of non-point source pollution, if a coordinated effort is made to emphasize the importance of the abed WSR as a unique natural resource.

A broader focus on watershed-based management of water resources inherently requires ongoing coordination and cooperation with other agencies. Partnerships are a key to effective watershed management. In the abed watershed, this approach has been demonstrated by the successful joint management of the Catoosa Wildlife Management Area by the NPS and the TWRA.

At the public workshop to gather comments aiding in developrnent of this document, landowners, recreationalists and agency representatives commented that rnore inforrnation sharing was needed. In addition to coordination and cooperation with other agencies, coordination and

OBRI-N-208.000
Priority: 8

cooperation is also important with upstream/watershed stakeholders, adjacent landowners, local communities, special interest groups, developers, and government officials involved in the water resources is essential to keep the Obed WSR National Park Service Unit fully aware of watershed activities, as well as serving as a mechanism for representing interests of the Obed WSR in the complex and, at tirnes, overlapping and seemingly contradictory efforts at water management.

Description of Recommended Proiect or Activity

The main objective of this project is to build partnerships for effective watershed management. Additional objectives are to keep the abed WSR National Park Service Unit abreast of watershed activities that may affect it, and serve as a mechanism for representing interests of the abed WSR in the complex and, at times, overlapping and seemingly contradictory efforts at water management.

The project will include these elements:

1. Initiate a central coordination effort to help fully realize cooperative potential between agencies.
2. Pursue coalitions between the abed WSR National Park Service Unit and adjacent private property owners to gain access to federal lands.
3. Develop programs designed to encourage BMP use on private lands.
4. Stay abreast of lands uses and activities on TWRA's Catoosa Wildlife Management Area for control and rnanagernent.
5. Encourage regular information sharing with regulatory agencies.
6. Develop a cooperative relationship with the Southern Appalachian Man And The Biosphere (SAMAB) foundation. SAMAB focuses on the Southern Appalachian Biosphere Reserve. The program its involved with encourages the utilization of ecosystem and adaptive management principles. The vision of the program is to:
   promote the achievement of a sustainable balance between the conservation of biological diversity, cornpatible economic uses and cultural values across the Southern Appalachians. This balance will be achieved by collaborating with stakeholders through information gathering and sharing, integrated assessments, and demonstration projects directed toward the solution of critical regional issues. The SAMAB Foundation will help raise funds, but to date it has not been successful in raising enough funds to significantly support regional projects, needed staff, and administrative expenses. The Foundation is working to attract more private sector partners and to involve local people more directly in SAMAB activities.
7. Support the establishment of a pilot Inter-agency Cooperative Ecosystern Study Unit (CESU) at the University of Tennessee/Knoxville. CESU is an inter-agency program that utilizes the services of one scientist from each agency involved in their support. These Units are dedicated to mission-oriented research.
8. Accomplishing Project Statements: OBRI-N-202, N-203, N-204, N-205, N-206, N207, N-209, N-210, N-211, N-212, N-215, N-216, N-218, N-219, N-220, N-221, N-222
9. Develop brochures dealing with the potential effects of development (i.e., residential construction, etc.) to the abed WSR's water resources.
10. Develop exhibits dealing with the potential effects of development (i.e., residential construction, etc.) to the Obed WSR's water resources.
11. Develop water use interpretive programs designed to make the general public aware of the importance of protecting the integrity of the Obed WSR's water resources for wildlife, water-related recreational activities, etc..

OBRI-N-208.000
Priority: 8

BUDGET AND FTE5

—	———--FUNDED - -		
	Source	Activity	Budget ($1 000's) FTE5
1999:			
2000:			
2001:			
2002:			
2003:			
		Total:	

UNFUNDED —

	Source	Activity	Budget (1 000's)	FTEs
1999:			6.0	0.1
2000:			6.0	0.1
2001:			6.0	0.1
2002:			6.0	0.1
2003:			6.0	0.1
		Total	30.0	0.5

Compliance codes:
Explanation:
End of data

OBRI-N-209.000

Priority: 9

Title: Establish an abed/Emory River Basin Team
Funding Status: Funded: 0.0 Unfunded: 36.0

Servicewide Issues: N10 (MINRL/GEOTHERM) N12 (WATER FLOW) NIl (WATER QUAL-EXT) N16 (NEAR-PARK DEV)

Cultural Resource Type: C70, C73

RMAP Program Codes: QOl, E00

Problem Statement

The primary purpose for the existence of the abed WSR is the protection and perpetuation of the so designated river reach in an essentially primitive condition, with unpolluted waters, for public enjoyment. A corn prehensive plan is needed to facilitate management of water resources within the National Park Service Unit. The effective management and ultimate "health" of the Obed WSR water resources is intimately linked to influencing land use patterns and practices in the abed WSR watershed. This potentially difficult task is complicated by the fact that much of the adjacent watershed acreage is not managed by the NPS. Instead, numerous stakeholders ranging from other federal, state, and local agencies, to commercial and other private interests contribute to a conglomerate of diverse rnanagernent goals and objectives.

In recognition of the necessity to involve non-NPS stakeholders in the protection of abed WSR resources, the National Park Service Unit management has investigated whether mechanisms exist to begin a coordinated approach for watershed-based water resources management protection. Initial contacts with WA and EPA (area pioneers with the watershed-based approach) indicate that they and other stakeholders are interested, but resources and staff time to develop an overall strategy are scarce. Currently, coordination and cooperation is occurring at the abed WSR National Park Service Unit among such agencies as WA, TWRA, and TDEC. However, the discrete offerings of each agency are in need of a central coordination effort to help fully realize cooperative potential.

Despite budget and personnel limitations prohibiting other agencies from taking a lead coordination role at this tirne, the NPS still retains a formidable impetus to move toward a coordinated, watershed-based approach. The Obed WSR GMP is strongly aligned with exploring this type of approach. In addition, the NPS Water Resources Division is supporting the investigation of existing water rights and means to protect these rights from injury.

A key realization is that development of a watershed-based water resources protection strategy is not identical to the traditional water resources planning tool - the WRMP. It is an outgrowth of recognizing: 1) the highest degree of interdependence of the well-being of the abed WSR on activities of other stakeholders in the drainage; and 2) that a proactive, stakeholderencorn passing, mutual gains approach is the most effective, long-term method for protection of water resource in the abed WSR. The difference from a traditional WRMP, sterns frorn cooperative and partnership approaches as the strategy's foundation as opposed to a WRMP where cooperation is often a critical element but not the central tenet.

OBRI-N-209.000

Priority: 9

Description of Recommended Proiect or Activity

The purpose of this project is to establish an abed/Emory River Basin Team for coordinating the activities of all stakeholders toward the best possible resource protection scherne. abjectives include: 1) develop a resources protection strategy, 2) develop a central coordination effort to help fully realize cooperative potential of this strategy, 3) cooperative irnplernentation of the strategy.

The project will include these elements:

1. Establish a watershed planning team including major stakeholders and users of water resources in the Obed/Ernory watershed.
2. The first task of the team would be to develop a watershed-based, water resources protection strategy to be used as a "blueprint" for coordinating the activities of all stakeholders. The blueprint may serve as a valuable example of innovative management to other NPS entities which are now grappling with the developrnent of new management tools for changing times and changing paradigms. The actual implementation of this project will consist of choosing a NPS staff rnernber (preferably the proposed Obed WSR, Resource Management Specialist - see Staff And Support Needs) who is capable of identifying an exhaustive list of stakeholders; developing a logical strategy for stakeholder involvement through which the water resources threats and the means to protect abed WSR water resources are identified and prioritized; motivating a cornrnitrnent on the part of stakeholders who may serve as the most appropriate lead on a particular issue; developing a framework for strategy implementation and operations; and devising a rnechanisrn(s) which is (are) capable of keeping all stakeholders informed and insuring that all stakeholder input is heard.
3. Cooperative irnplernentation of the strategy.

OBRI-N-209.000
Priority: 9

BUDGET AND FTEs

—C- -FUNDED

	Source	Activity	Budget ($1 000's)	FTEs
1999:				
2000:				
2001:				
2002:				
2003:				
		Total:		

-

———UNFUNDED—

	Source	Activity	Budget (1000's)	FTE5
1999:			14.0	0.2
2000:			14.0	0.2
2001:			8.0	0.1
2002:				
2003:				
		Total	36.0	0.5

Compliance codes:
Explanation:
End of data

OBRI-N-21 0.000
Priority: 10

Title: Assess and Establish Long-term Hydrologic Inventory and Monitoring Network
Funding Status: Funded: 0.0 Unfunded: 98.0

Servicewide Issues: Ni 1 (WATER QUAL-EXT)
N20 (BASELINE DATA)

Cultural Resource Type: C70

RMAP Program Codes: QOl

Problem Statement

Water is the dominant feature of the abed WSR. “The quantity and quality of waters in the abed WSR sustain and nourish a rich variety of outstandingly remarkable values. The abed WSR contains an outstanding example of deep sandstone gorge with high stream gradients which together direct whitewater flows down boulder-strewn courses intermingled with quiet, smooth flowing stretches. The water is clear and is considered to be among the highest quality in the State” (NPS 1995). The characteristic, widely fluctuating but natural, flow patterns of the rivers flowing into and part of the abed WSR have maintained the river course and it’s aquatic communities for rnillenia. The abed WSR is situated mid-drainage in the abed/Emory watershed. With the level of regional developrnent now occurring, water supply within the abed/Emory watershed is becoming a growing concern. From 1988 to 1994 alone, 1,767 impoundments were constructed in the abed watershed for a total of 2,903 impoundments since 1943 (Bowling, WA, personal communication). The 2,903 impoundments include 42 reservoirs that are larger than 2 acres (0.8 hectares) in size (Bowling, WA, personal communication). An additional water supply irnpoundrnent is proposed on Clear Creek, upstream of the abed WSR boundary. This expanding demand for agricultural use and regional or rnunicipal water supplies in the watershed are likely altering natural flow patterns of the abed/Emory River.

Depending upon construction and site characteristics, residential and commercial development and mining activities, such as are occurring in the Obed/Ernory watershed, can also alter base flows and the amount of stormwater runoff to the river. This progression of private and public development in the watershed, again highlights the ever increasing importance knowledge of existing hydrology and monitoring of hydrological effects.

The lack of flow monitoring capability within the National Park Service Unit precludes documentation of existing conditions and assessment of potential future effects on the water resources of the abed WSR. The growing influence of external water issues on the National Park Service Unit warrants correction of the Unit’s current lack of hydrologic monitoring effort and of the ability to manage ecological resources (including federally-listed, threatened or endangered aquatic species) and provide for recreational uses (such as canoeing or kayaking) without a single flow monitoring station within the Unit until 1997.

Presently two stream gages measure flow in the entire Obed/Ernory watershed. The USGS aakdale gage on the lower Emory River, well downstream and outside the National Park Service Unit, has an excellent long-term period of record frorn 1927 to present. The stream gage at Lilly Bridge on Clear Creek began operation in 1997 as part of the cooperative efforts establishing the abed WSR as a new USGS NAWQA study stream reach. This gage will operate for at least the first two years of intensive sarnpling done at NAWQA stations. These two gage sites do not allow adequate flow representation of all major watersheds undergoing reservoir development, and flowing into the Obed WSR. The abed WSR needs to know substantially more about the structure and function of it hydrologic systems and water-dependent environments.

OBRI-N-21 0.000
Priority: 10

The current monitoring effort would need expanding to include an aaaitionai tnree screarn gages. Establishment of three additional gaging sites would provide definitive information to define baseline hydrological relationships and conditions among the tributaries in the Obed WSR. Long-term sites would also provide a tool for assessing development-related alterations to flow patterns in specific reaches of the watershed. In addition, biological and water quality data being gathered by other agencies and the Park Service frorn inside and near the abed WSR could be linked to the existing hydrologic data as a cost-effective way of enhancing abed WSR efforts to protect the overall integrity of the river system.

Description of Recommended Proiect or Activity

To adequately monitor how watershed modifications are effecting stream flow in the abed WSR National Park Service Unit, three additional stream flow gages should be installed within the Unit (Daddys Creek at Antioch Bridge, abed River at Alley Ford, and the abed River at Adams Bridge). The NPS should coordinate with USGS in the placement and monitoring of these gages. In order to develop a thorough database, incorporating historical through present-day data, currently available water stage data should be collected frorn WA, USGS, and TDEC. This data should then be used to develop a hydrologic network model.

The objective of this project is to develop an enhanced program of hydrologic inventory and monitoring to identify impacts to stream flow due to activities in the watershed as well as develop status and trends information and allow the projection of irnpacts due to these activities.

The project will include these elements:

1. Assess the adequacy of existing stream gaging in the Obed WSR and the abed/Emory watershed.
2. Likely install three stream gaging stations (Daddys Creek ~ Antioch Bridge, abed River at Alley Ford, abed River at Adams Bridge) for a period of three to five years to collect baseline strearn flow data for use in quantifying the effects of watershed modification.
3. Acquire existing water stage data from external sources (i.e., TVA, USGS, and TDEC).
4. Identify appropriate water stage data for Obed WSR's water stage database.
5. Coordinate with USGS in the placement and monitoring of gages.
6. Model hydrologic network (which will allow the fine-tuning of future rnonitoring efforts).

OBRI-N-210.000
Priority: 10

BUDGET AND FTEs

----—–—-------—-----—-———---FUNDED -

	Source	Activity	Budget ($1 000's)	FTEs
1999:				
2000:				
2001:				
2002:				
2003:				
		Total:		

—-—-—-—UNFUNDED———-—

	Source	Activity	Budget (1000's)	FTEs
1999:			24.0	0.3
2000:			74.0	0.5
2001:			11 0*	0.1*
2002:			11.0*	0.1*
2003:			11.0*	0.1*
		Total	98.0	0.8

Cornpliance codes:

Explanation:

End of data

* Long-term base budget

OBRI-N-21 1.000
Priority: 11

Title: Initiate a Groundwater Monitoring Program
Funding Status: Funded: 0.0 Unfunded: 54.0

Servicewide Issue: NI I (WATER QUAL-EXT) NI 3 (WATER RIGHTS) Nl2 (WATER FLOW) N20 (BASELINE DATA)

Cultural Resource Type: C70, C73
RMAP Program Codes: QOl, C03

Problem Statement

Water resources and riparian environrnents are principal resources of the Obed WSR. The water is considered to be among the highest quality in the State of Tennessee - supporting a rich ecological diversity. However, activities occurring outside the Obed WSR Park Service Unit influence the waters within its boundaries. The population in Cumberland County has grown by 13 percent from 1990-I 995, and growth is expected to continue based on current trends. Expanding groundwater pumping due to ever increasing development in the Obed/Ernory watershed raises concern that water quantity in the Obed WSR could soon be impacted. Although the watershed hydrological rnonitoring network includes stations for gaging stream levels and flows, integral groundwater level measurements are essentially non-existent (with the possible exception of low flow data). A groundwater monitoring program represents the best possible cost/benefit solution to this problem.

Recharge is an important consideration in the potential development of groundwater supplies in the watershed area. Under natural conditions, seasonal variations in precipitation affect groundwater storage in the abed/Emory watershed, with the lowest levels occurring in the fall when flows are at their lowest creating a critical time for most aquatic species. If this natural sequence of events is compounded by increasing domestic demand for groundwater, long-term lower than normal flows could result.

Description of Recornrnended Project Activity

This project will require incorporation of a groundwater monitoring component into the existing hydrologic monitoring network. This could best be accomplished by providing field assistance to the TDEC and USGS for installation of groundwater monitoring sites within the abed WSR watersheds. This could then be followed by the incorporation of groundwater monitoring data into the Obed WSR's hydrology database.

The project will include these elements:

1. Coordinate with TDEC, TWRA, and USGS in order to obtain the following information on the watershed: the number of wells, trends in numbers of wells, location of wells, amount of pumping, and water tables.
2. Determine the hydrologic regime before the study and coordinate the installation of groundwater monitoring wells and staff plates with TDEC and USGS.
3. Identify appropriate locations and rnethods for groundwater monitoring in conjunction with the existing monitoring network.
4. Establish protocols for obtaining groundwater monitoring data from TDEC and USGS.
5. Analyze results of groundwater and surface water monitoring for use in Project Statement aBRl-N-2I9.
6. Incorporate the results in NPS-useful format and identify criteria designating "problem areas."

OBRI-N-21 1.000
Priority: 11

BUDGET AND FTEs

——-FUNDED----—

Source	Activity	Budget ($1 000's)	FTE5
1999:			
2000:			
2001:			
2002:			
2003:			
	Total:		

—-————UNFUNDED-———-—

Source	Activity	Budget (1000's)	FTEs
1999:		27.0	0.03
2000:		27.0	0.03
2001:			
2002:			
2003:			
	Total	54.0	0.06

Compliance codes:
Explanation:
End of data

OBRI-N-2l 2.000
Priority: 12

Title: Study the Influence of Groundwater and Groundwater Recharge
Funding Status: Funded: 0.0 Unfunded: 94.0

Servicewide Issues: Nl I (WATER QUAL-EXT) NI 3 (WATER RIGHTS) N12 (WATER FLOW) N20 (BASELINE DATA)

Cultural Resource Type: C70, C73

RMAP Program Codes: QOl, C03

Problern Statement

Water resources and riparian environrnents are principal resources of the Obed WSR. The water is considered to be among the highest quality in the State of Tennessee - supporting a rich ecological diversity. However, activities occurring outside the abed WSR Park Service Unit influence the waters within its boundaries. Quantitative information concerning aquifer recharge and hydraulic characteristics is necessary to manage the development of groundwater resources. These characteristics are poorly defined for the aquifers of the abed WSR watershed. The increased installation of groundwater supply wells adjacent to streams both inside and outside of park boundaries could result in reduced groundwater recharge and alteration of natural stream flows. Considering that present cumulative irnpacts of groundwater withdrawals is unknown, and future groundwater supply wells for industry and municipalities might be targeted toward higher yield locations (i.e. near streams), an assessment of potential impacts is warranted.

Surface-subsurface water relationships within the abed WSR watershed are complex due to spatial and temporal variabilities in hydrogeology and meteorology. Additionally, anthropogenic influences (e.g., groundwater withdrawals, impoundment construction, mining, quarry operations, forestry practices) on groundwater resources of the watershed due to present and ensuing development have not been quantified. Therefore, it is important to acquire a more complete understanding of the existing surface-subsurface interactions and potential modifications by mankind.

Description of Recornrnended Project or Activity

This project will require an estimation of aquifer recharge/discharge rates near strearns within the abed WSR watershed with particular ernphasis to wells developed in the fiuvial and colluvial deposits adjacent to streams. Existing groundwater withdrawals within the watershed will have to be quantified.

Additionally, protocols for evaluating future groundwater supplies within the watershed will have to be developed.

The project will include these elements:

I. Due to the lack of information, seek technical assistance to locate any bits of real data or expert opinions that might be available.
2. Seek technical assistance from NPS Water Resources Division to develop protocols for evaluating future groundwater supplies based upon aquifer characteristics, stream recharge, and stream sensitivity.
3. Analyze results of groundwater (Project Staternent OBRI-N-21 1) and surface water monitoring to estimate aquifer recharge/discharge rates near streams and identify base flow component for water balance.

OBRI-N-21 2.000
Priority: 12

4. Obtain groundwater supply data from the TDEC to quantify existing groundwater withdrawals within the watershed.
5. Explore the legal aspects of the problem to determine if any laws and regulations for managing groundwater offer any remedies for problems that are discovered in this study.

OBRI-N-21 2.000
Priority: 12

BUDGET AND FTEs

—— —---FUNDED—————————————

	Source	Activity	Budget ($1 000's)	FTEs
1999:				
2000:				
2001:				
2002:				
2003:				
		Total:		

—— UNFUNDED————————

	Source	Activity	Budget (1000's)	FTEs
1999:			44.0	0.03
2000:			50.0	0.03
2001:				
2002:				
2003:				
			Total 94.0	

Compliance codes:
Explanation:
End of data

OBRI-N-21 3.000

Priority: 13

Title: Acquire Access to Geographic Information System (GIS)
Funding Status: Funded: 0.0 Unfunded: 55.0

Servicewide Issues: N16 (NEAR-PARK DEV)
N20 (BASELINE DATA)

Cultural Resource Type: C70, C73

RMAP Program Codes: QOl, C03

Problem Statement

Present knowledge of the spatial interrelationships of various resources within the abed WSR National Park Service Unit is inadequate for proper resource management. The abed WSR has no automated, centralized database in which to maintain inforrnation about land use, land ownership, biological and cultural resources, water resource rnonitoring, wetland data, and impoundments, nor does it have the means by which to create, manage, analyze, and display mapped information about these resources.

The abed WSR National Park Service Unit does not have a GIS work station, a recognized GIS position, or funds available for either nor may this be practical. Although the Big South National River and Recreation Area has a GIS work station, it's current support of the abed WSR is inadequate for water resource managernent purposes. In addition, resource data collected over the years is scattered between state and federal agencies and in some cases, such as the USFWS wetlands data, it disappeared. Institutionalization of resource data collection into one centralized database for storage, retrieval, and problem solving is required. Data becomes more understandable and useful for managers and scientists when entered into a GIS system for subsequent study and analyzation.

With access to a GIS workstation, the NPS could store and retrieve all data gathered. Access to a GIS workstation and platform appropriate for the needs of the abed WSR is an essential tool for management and practical hand on activities.

A significant challenge is faced for resource management when traditional methods are utilized to integrate thematic data composites derived from natural and cultural resource information. Resource management plans are, by their nature, limited in illustrating long-term, inconspicuous and subtle changes in the health of natural resources. External threat pressures frorn conflicting land use practices (agriculture, oil and gas exploration, etc.) and demographic changes are increasing at an alarming rate.

A GIS system would be instrumental in recording new information, detecting changes, analyzing trends, and projecting possible future conditions resulting from these external resource pressures. A complete picture of the various inventory and monitoring prograrns could be organized into one, centralized database by GIS. With the ability to overlay different data sets, GIS could be used to combine land use, land ownership, biological and cultural resources, water resource monitoring, wetland data, and impoundments information. In order to insure the most thorough database possible, all cooperative projects and programs need to insure that appropriate GIS related databases are developed so that the information can be effectively managed and used. GIS analysis will give the NPS the ability to model impacts of rnajor projects or land use changes in the abed/Emory watersheds to the abed WSR. The abed WSR needs to have a readily available and cost effective system.

OBRI-N-21 3.000

Priority: 13

Description of Recorn mended Proiect or Activity

The objectives of this project are to consolidate various types of inventory and monitoring data into a single format and to utilize a GIS system to keep detailed records, map abed WSR boundaries and ownership patterns, and to model impacts of land use changes in the lands external to the abed WSR.

The project will include these elements:

I. Key resource rnanagernent personnel attend a G1S orientation program
2. Acquire access to a GIS workstation and platform appropriate for the needs of the Obed WSR and obtain staff time to enter and analyze data.
3. Determine data needs for GIS coverage (e.g., slope, topography, soils, abed WSR boundaries; watershed boundaries; land ownership within the abed WSR; land uses within the abed WSR and in the overall watershed; road network; locations of mines/quarries/abandoned and active oil and gas wells; impoundments; water quality monitoring sites and data; biological rnonitoring sites and data).
4. Coordinate with state and federal agencies to acquire and share existing data or GIS resources.
5. Input data into GIS.
6. Utilize data in ongoing abed WSR National Park Service Unit's decision-rnaking and to determine areas where the potential for impacts to the abed WSR's water resources exist.

OBRI-N-21 3.000
Priority: 13

BUDGET AND FTEs

FUNDED

	Source	Activity	Budget ($1 000's)	FTE5
1999:				
2000:				
2001:				
2002:				
2003:				
		Total:		

UNFUNDED

	Source	Activity	Budget (1000's)	FTEs
1999:			2.0	0.03
2000:			37.0	0.03
2001:			12.0	0.03
2002:			2.0	0.03
2003:			2.0	0.03
		Total	55.0	0.15

Compliance codes:
Explanation:
End of data

OBRI-N-21 4.000

Priority: 14

Title: Develop a Continuous Hydrologic Watershed Model
Funding Status: Funded: 0.0 Unfunded: 162.0
Servicewide Issues: NI 2 (WATER FLOW) N20 (BASELINE DATA)
N16 (NEAR-PARK DEV)

Cultural Resource Type: C70, C73

RMAP Program Codes: QOl, C03

Problem Statement

Water resources and riparian environments are principal resources of the Obed WSR. The water is considered to be among the highest quality in the State of Tennessee - supporting a rich ecological diversity. However, activities occurring outside the Obed WSR Park Service Unit influence the waters within its boundaries. These activities include: coal mining, oil and gas exploration, quarrying, sewage discharge, agriculture and forestry practices, some residential development, garbage disposal and construction of numerous water supply ponds and impoundments on tributaries of the abed and Emory rivers.

Presently the effects of any proposed adjacent land use and monitoring alteration on both water quantity and quality on basin streams within the Obed WSR are unpredictable. A continuous hydrologic watershed model would allow Obed WSR officials to model and predict hydrologic effects of major land use changes prior to a change actually being implemented.

Description of Recommended Proiect or Activity

The objective of this model is to predict how land use changes in the watershed (due to development, agriculture, etc.) will impact flow prior to a change actually being implemented. Although, we realize that it would not be practical to attempt to construct such a model with our current knowledge of the hydrologic properties and attributes of the watershed.

Land use (on or off federal property) in the Obed/Emory watersheds can be regulated to a certain extent by TDEC through the agency's permitting process for activities such as sewage and wastewater collection systems, septic tanks, landfills, industrial effluent, storm water discharge, etc.. The NPS can participate in the regulating process by monitoring land use in the watershed (see Project Statement OBRI-N-215) and reporting any possible violations to TDEC.

The project will include these elements:

1. Develop hydrologic watershed model (based on WA, USGS, and TWRA data) in order to model both water quantity and water quality and continuously update the hydrologic model using land monitoring data, etc.. A description of the Park Unit, rivers and watershed will be necessary in order to construct this model.
2. Input land monitoring data into the model to quantify the effects of proposed land use changes on basin streams.
3. Use the outputs of the watershed model to predict the potential affect from watershed land use changes.

OBRI-N-21 4.000
Priority: 14

BUDGET AND FTEs
—----FUNDED

	Source	Activity	Budget ($1 000's)	FTE5
1999:				
2000:				
2001:				
2002:				
2003:				
		Total:		

—	—--UNFUNDED

	Source	Activity	Budget (1000's)	FTE5
1999:			81.0	0.1
2000:			81.0	0.1
2001:				
2002:				
2003:				
		Total	162.0	0.2

Compliance codes:
Explanation:
End of data

OBRI-N-21 5.000
Priority: 15

Title: Develop Long-term External Land Use Monitoring
Funding Status: Funded: 0.0 Unfunded: 53.0

Servicewide Issues: Ni 1 (WATER QUAL-EXT)
N20 (BASELINE DATA)

Cultural Resource Type: C70, C73

RMAP Program Codes: QOi, C03

Problem Statement

Current impacts to water resources in the Obea WSR are the result of land use activities both within and outside its boundaries. Private lands within the Obed WSR drainage are used for agriculture, timber harvesting, oil and gas exploration, mining, and residential development. Eariy detection of land use changes through monitoring can provide "leading edge" wamings of impacts on water resources and provide time needed to address those issues before serious negative impacts occur. The impact of land use activities, as well as the impact of increased residential and commercial development in the upper abed and the associated impacts to water quality and quantity in the lower abed cannot be adequately determined at this time. No system is in place for NPS monitoring of land use or for inter-agency coordination of activities in the watershed.

Other agencies conduct water resource-related activities in the abed/Emory watershed. NRCS staff are actively involved in agricultural land use assessment, monitoring, and management. A working relationship between the NPS and NRCS is important, especially with regards to promoting agricultural best-management practices to reduce the impact of livestock and farming activities on water quality. TDEC's Water Pollution Control Division is in the initial stages of implementing a watershed approach to water quality monitoring, NPDES permitting, and municipal and industrial discharge permitting. The Emory River watershed will be one of the first watersheds in the state to be regulated and monitored in this way. NPS coordination with TDEC to obtain monitoring data, information regarding permitting activities in the watershed, and other water resource protection efforts is an important step to implementing objectives of the WRMP.

Detailed information about land use on non-federal lands that have not been acquired by the NPS and those immediately adjacent to the abed WSR boundaries is also needed. There are currently about 3,292.7 acres (1,332.5 hectares) of non-federal lands in the abed WSR project boundaries. Agriculture, mining, logging, and residential development all occur on areas Congressionally authorized for inclusion within the abed WSR boundaries, the TWRA's Catoosa Wildlife Management Area and its associated land uses are also a potential concem to water resources in the abed WSR. The land uses and activities on these lands should be continually monitored for their effects on NPS managed water resources.

(See Project Statement N-208 for Coordination/Coalition Building). Description of Recommended Proiect or Activity

The main objective of this project is to control and manage impacts to water resources in the abed WSR as a result of land use activities both within and outside its boundaries. An additional objective, is to acquire detailed information about land use on non-federal lands that have not been acquired by the NPS and those immediately adjacent to the abed WSR boundaries.

OBRl-N-2i 5.000

Priority: 15

The project will include these elements:

I. Historic and current land use data including aerial and Lansat imagery is not maintained by the abed WSR. Compile this data for inclusion in GIS/baseline assessment.
2. The abed WSR Park Service Unit should take a proactive approach on land use decisions. This would include actively searching public notices, participating in planning committees and zoning meetings, getting on mailing lists for notification of planning efforts, and reviewing state NPDES discharge permit applications. This task will require a commitment of time from the superintendent and resource manager, and some travel funds.
3. NPS contacts should be placed on notification lists for mining permits, TDEC Water Pollution Control public notice list, U.S. Army Corps of Engineers public notice boards who are responsible for review and approval of development.
4. Update land use information into the GIS database as it becomes available.

OBRl-N-21 5.000
Priority: 15

BUDGET AND FTE5
—-FUNDED

	Source	Activity	Budget ($1 000's)	FTEs
1999:				
2000:				
2001:				
2002:				
2003:				
		Total:		

UNFUNDED———————

	Source	Activity	Budget (1000's)	FTEs
1999:			33.0	0.1
2000:			5.0	0.05
2001:			5.0	0.05
2002:			5.0	0.05
2003:			5.0	0.05
		Total	53.0	0.3

Compliance codes:
Explanation:
End of data

OBRI-N-2i 6.000
Priority: 16

Title: Assess and Mitigate Silvicultural Impacts
Funding Status: Funded: 0.0 Unfunded: 73.0

Servicewide Issues: Ni I (WATER QUAL-EXT)
N20 (BASELINE DATA)

Cultural Resource Type: C70, C73
RMAP Program Codes: QOi, CO3

Problem Statement

Water resources and riparian environments are principal resources of the abed WSR. The water is considered to be among the highest quality in the State of Tennessee - supporting a rich ecological diversity. However, activities occurring outside the abed WSR Park Service Unit influence the waters within its boundaries. These activities include: coal mining, oil and gas exploration, quarrying, sewage discharge, agriculture and forestry practices, some residential development, garbage disposal and construction of numerous water supply ponds and impoundments on tributaries of the abed and Emory rivers.

Historical water quality data have shown that agricultural and/or forestry practices are the primary impacts to the abed WSR and its tributaries (Rikard 1985). Silvicultural activities in the abed/Emory watershed are primarily small-scale forestry operations managed by independent contractors, and average 50 acres (23.23 hectares) or less (Bible, Tennessee Department of Forestry, personal communication). Some 150 to 200 acres of trees per year are harvested from the Catoosa Wildlife Management Area. The primary harvesting method is selective cutting/selective regeneration (Amold, Tennessee Department of Forestry, personal communication). Large-scale industrial-type forestry operations (greater than 100 acres or 40.46 hectares), operated by forestry industries such as Bowater and Champion International exist in Morgan and Scott counties, but are not in the abed/Emory Watershed (Bible, Tennessee Department of Forestry, personal communication). Silviculture practices outside of the abed WSR have, through increased sedimentation due to poor road construction, the potential to affect the quality of waters entering the abed WSR through increased sediment load.

The abed WSR does not have an inventory of private and commercial silviculture operations upstream of its boundaries. However, it is known that a new hardwood chipmill sited nearby the abed WSR is within the 50 mile radius sourcing area from which timber is supplied. This type of operation could potentially impact abed WSR water resources as described above. The TDEC's Department of Forestry does not closely monitor total acreage devoted to silviculture. Therefore, this department cannot currently provide specific information regarding increases and decreases in silviculture practices.

An inventory of extemal silviculture practices will provide a baseline for monitoring trends, making it possible to identify new sources of impacts to water quality, and allow the abed WSR to become a more effective participant in regional planning.

Description of Recommended Proiect or Activity
This project will require coordination with TDEC Department of Forestry in order to develop a detailed inventory of extemal silviculture practices and to identify those that pose potential threats to water resources of the abed WSR. The primary objective of the project is to provide a more comprehensive inventory database of silviculture operations that will allow the abed WSR to identify potential impacts before resource damage occurs, provide a baseline from which to

OBRI-N-21 6.000
Priority: 16

monitor silviculture trends and to effectively use regional planning and mitigation to protect the resources of the abed WSR.

The project will include these elements:

1. Coordinate with TDEC's Department of Forestry to inventory the total private and commercial acreage devoted to silviculture operations upstream of the abed WSR.
2. Working with TDEC's Department of Forestry, identify locations of silvicuture operations that may be impacting the WSR's water resources.
3. Develop a cooperative relationship with TDEC's Department of Forestry so as to allow for better information exchange conceming silvicultural practices in the watershed.
4. Assess usage of silvicultural BMPs within the abed/Emory watershed.
5. A GIS layer of silvicultural practices (both current forest cover with annually or biannually updated scenes) needs to be developed or procured and incorporated into the Park Unit's GlS in order to track land-use change and water quality relative to sivilcultural activities. Information on this GlS map should include the location of the chip mill, the watershed and sub-watersheds, roads, rivers, WSR boundary, and areas of existing and potential timber harvesting. Other aspects of the setting to include are the amount of timbering currently occurring and observed impacts. This element is predicated on the abed WSR having access to a GIS. See Project Statement aBRl-N-21 3.
6. Assess impacts of current and future cultivation and harvest of timber and develop a program to effectively interact with silvicultural industry in the watershed to maximize use of BMPs.

OBRI-N-2i 6.000
Priority: 16

BUDGET AND FTEs

—---------- FUNDED—-------–——

	Source	Activity	Budget ($1 000's)	FTEs
1999:				
2000:				
2001:				
2002:				
2003:				
		Total:		

—-— UNFUNDED

	Source	Activity	Budget (1000's)	FTE5
1999:			22.0	0.2
2000:			22.0	0.2
2001:			29.0	0.2
2002:				
2003:				
		Total	73.0	0.6

Compliance codes:
Explanation:
End of data

OBRI-N-21 7.000
Priority: 17

Title: Monitor and Mitigate Impacts of Oil and Gas Operations
Funding Status: Funded: 0.0 Unfunded: 65.0

Servicewide Issues: NI 0 (MINRL/GEOTHERM)
N20 (BASELINE DATA)

Cultural Resource Type: C70, C73
RMAP Program Codes: QOl, CO3

Problem Statement

Water resources and riparian environments are principal resources of the abed WSR. The water is considered to be among the highest quality in the State of Tennessee supporting a rich ecological diversity. However, active oil and gas operations both inside and outside abed WSR boundaries pose a potential pollution threat to its water resources. Seven oil and gas operations occur within the abed WSR boundaries. Four of these sites are active; three are abandoned. Two of the inactive operations are on federal land one on the south side of Clear Creek, east of White Creek, and another northwest of Lilly Bridge. The remaining five operations are private in-holdings but occur within the current boundary.

Currently, road construction is the worst impact from oil and gas operations in the abed WSR watershed, brine disposal in the watershed is the second worst impact. Chemical and petroleum by-products of the production process from active operations and leakage from abandoned wells could impact water quality. In addition, privately owned oil and gas leases in the vicinity of the abed WSR boundaries pose a continual threat to water quality. Therefore, activity in these areas should to be assessed and a system developed to monitor future activities.

Description of Recommended Proiect or Activity

This program will require the abed WSR to work closely with the oil and gas operators and state inspectors during all exploration, drilling, and production operations. The objective of the program is to provide an early warning monitoring network of the local water resources for active and abandoned oil and gas operations and to reclaim the two inactive sites located within the boundaries.

The project will include these elements:

1. With input from TDEC's Department of Geology, identify the locations of active and abandoned oil and gas operations in the abed watershed, for inclusion in baseline land use assessment and mapping projects.
2. Since the locations of oil and gas operations are not accurately known by the NPS, when determined, include the exact location of the operations relative to the abed WSR boundaries on a GIS map to assist in determining their potential for impact to water quality.
3. Document and describe any observed spills, road erosion or other impacts and immediately report them to the TDEC. This can best be accomplished by field reconnaissance, contacts with operators, annual site visits, and technical assistance from the NPS Geologic Resources Division.
4. Develop and implement plans to identify and assess impacts of oil and gas operations inside abed WSR boundaries.
5. Verify and monitor proper road construction and disposal of waste material.
6. Develop and implement mitigation projects addressing identified impacts.

OBRl-N-21 7.000
Priority: 17

7. Design and implement a system to readily reclaim inactive sites located within the abed WSR boundaries.

OBRl-N-21 7.000
Priority: 17

BUDGET AND FTEs

—	—FUNDED-———-——		
	Source	Activity	Budget ($1 000’s) FTEs
1999:			
2000:			
2001:			
2002:			
2003:			
		Total:	

UNFUNDED

	Source	Activity	Budget (1 000’s)	FTE5
1999:			2.0	0.03
2000:			11.0	0.1
2001:			26.0	0.1
2002:			26.0	0.1
2003:				
		Total	65.0	0.33

Compliance codes:
Explanation:
End of data

OBRI-N-218.000
Priority: 18

Title: Identify and Monitor lmpaéts from both Surfaced and Unsurfaced Roads
Funding Status: Funded: 0.0 Unfunded: 26.0

Servicewide Issues: N06 (LAND USE PRAC) N18 (VIS USE-BCTRY) Nil (WATER QUAL-EXT)
N20 (BASELINE DATA)
N16 (NEAR-PARK DEV)

Cultural Resource Type: C70, C73
RMAP Program Codes: QOl, Ca3, oaa

Problem Statement

From examining maps, it is believed that there are approximately twelve miles of surfaced and unsurfaced roads located within the abed WSR boundaries. The total mileage of surfaced and unsurfaced roads within the abed/Emory watershed is unknown but believed to by quite large. Since this is a rural area, unsurfaced roads are typical ways to access scattered residences, woodlots, farms and recreation sites.

Water resources and riparian environments are principal resources of the abed WSR. The water is considered to be among the highest quality in the State of Tennessee - supporting a rich ecological diversity. Sedimentation from these surfaced and unsurfaced roads poses a threat to the abed WSR water quality. However, it is difficult to determine and to separate the impacts of the roads from all the other sources of similar sediment within the basin. Therefore, monitoring should take place on and immediately adjacent to the rpads to determine erosion of the road material and delivery into the adjacent seasonal streams and ditches.

Description of Recommended Proiect or Activity

This project will include the inventory of surfaced and unsurfaced roads within the abed/Emory watershed, along with monitoring the associated impacts. The objective of the program is to monitor surfaced and unsurfaced road impacts on the water resources and identify sites which are significantly degrading the water resources. These efforts will emphasize the identification of existing and potential sediment problems at the source, where they can be addressed with assistance from the TDEC before becoming water quality problems.

A cooperative approach between the NPS and TDEC is recommended for this project. TDEC regulates/enforces mud or sediment discharge coming off of unstabilized road surfaces (both private and public). Typical remedies requested by TDEC include: installation of a durable road surface (either pavement or rock), adequate number of culverts to get flow off of road, stabilization of the “cut” into the hillside, and placement of fill material on the down-slope of the road.

The project will include these elements:

1. Use aerial photographs to determine the location and total mileage of surfaced and unsurfaced roads within the abed/Emory watershed and classify them based on width and surface condition.
2. Use GIS techniques to identify areas of concern based on soil types, slope, hydrology, and occurrences of roads.
3. Develop impact criteria and monitoring strategy to assess effects of surfaced and unsurfaced roads receiving high priority status inside abed WSR boundaries.

OBRI-N-21 8.000
Priority: 18

4. Identify, prioritize, and monitor impacts of surfaced and unsurfaced roads inside abed WSR boundaries for inclusion in baseline lands use assessment and mapping project.
5. Work with counties, communities and land owners to develop mitigation plans as needed.
6. Report observed violations (i.e., collapsed silt fences, etc.) outside the Park Unit boundaries to TDEC.

OBRI-N-2l 8.000
Priority: 18

BUDGET AND FTEs

— FUNDED —			
	Source	Activity	Budget ($1 000's) FTEs
1999:			
2000:			
2001:			
2002:			
2003:			

Total:

UNFUNDED —-			
	Source	Activity	Budget (1000's) FTEs
1999:			18.0 0.1
2000:			2.0 0.03
2001:			2.0 0.03
2002:			2.0 0.03
2003:		2.0 0.03 Total	26.0 0.22

Compliance codes:

Explanation:

End of data

OBRI-N-2i 9.000
Priority: 19

Title: Assess the Impacts of Coal Seams and Pyritic Shales on Water Quality
Funding Status: Funded: 0.0 Unfunded: 150.0

Servicewide Issues: NIO (MINRLJGEOTHERM) N16 (NEAR-PARK DEV) NI I (WATER QUAL-EXT) N20 (BASELINE DATA)

Cultural Resource Type: C70, C73
RMAP Program Codes: QOl, Ca3, DOO

Problem Statement

Water resources and riparian environments are principal resources of the abed WSR. The water is considered to be among the highest quality in the State of Tennessee - supporting a rich ecological diversity. However, mining activities currently occurring and that have occurred outside the abed WSR Park Service Unit influence the waters within its boundaries. The abed WSR watershed is underlain by coal seams and pyritic shales (e.g., Whitwell Shale) that, when disturbed or exposed, can seriously degrade surface and groundwater quality. Disturbance of these geologic formations results from mining activities (e.g., coal, gravel, and sand) and general construction activities such as road building. The primary problem associated with mining and disturbance of these formations is the production of acidic leachate and runoff due to the oxidation of pyritic materials. High acidity also poses the potential of leaching heavy metals from the rocks. Many discrete and cumulative impacts of formation disturbance to surface and groundwater are unknown. This is primarily due to staff limitations of monitoring agencies, inadequate monitoring protocols and sampling networks, indifference to regulations, poor reclamation practices, and/or lack of understanding by mine operators. Therefore, it is important to identify the locations of problematic formations in three dimensions, and quantify existing water resource problems as they relate to mining and construction activities.

Coal mining activities within the watershed are regulated by the affice of Surface Mining (USOSM) and some amount of surface water quality monitoring is usually required at mining sites. Strip-mining is a common method for accessing coal seams in this area. Other mining activities (e.g., sand and gravel) that occur in the watershed are monitored by the Tennessee Department of Environment and Conservation (TDEC) and water quality monitoring of runoff is sometimes required. In areas where coal seams and/or pyritic shales reside at relatively shallow depths, common development and construction activities (e.g., roadway construction) can result in formation disturbance and subsequent impacts to surface and groundwater. These effects are most apparent at or near the site of disturbance and generally diminish downgradient/downstream due to natural processes such as dilution and buffering.

Potential pollutants from coal mines and pyritic shales can be organic and inorganic in nature. Inorganic materials (minerals) are always present. Inherent elements are primarily iron, phosphorous, sulfur, calcium, potassium, copper, lead, and magnesium. Extraneous matter is dependent on coal/pyritic shale composition and might include carbonates, silicates, alumina, pyrite and marcasite (sulfide), ferrous oxide, ferrous sulfate, ferrous carbonate, organic iron, calcium sulfate, and phosphates. These elements are primarily rock constituents; therefore, the geographical source of will affect the solute concentrations of leachate and runoff. Potential trace inorganic (e.g., arsenic, selenium, cadmium, boron, chromium) and organic pollutants are also associated with coal/pyritic shale. However, the geographical source will ultimately affect the solute concentrations of leachate and runoff.

OBRI-N-21 9.000
Priority: 19

Leachate production and runoff is a product of climatic and physiographic factors. The many factors influence the relationship between runoff and precipitation. Factors such as storm frequency, initial soil and coal/shale moisture conditions, storm duration, and temperature are important. The initial oxidation of freshly exposed coal/shale falls off rapidly with time and is proportional to the total surface area of the material (particle size and gradation). Freshly fractured particles are more susceptible to oxidation. Fresh surfaces are also created by precipitation as it removes pyritic oxidation products. The fresh surfaces permit regeneration of oxidation products until the next precipitation event, at which time they are washed out again. Leachate production and runoff solute concentrations are generally highest in the first precipitation episode after dry periods. Solute concentrations will also be higher as fresh material is exposed.

The most widely recognized problem associated with coal mining and disturbance of pyritic shale is the production of acidic leachate and runoff due to the oxidation of pyritic materials within the rocks. High acidity also poses the potential of leaching heavy metals from the rocks. This can happen through secondary reactions of sulfuric acid with minerals and organic compounds in the exposed coal/pyritic shale and along the runoff route.

Description of Recommended Proiect or Activity

This project will include quantifying discrete and cumulative water resource problems as they relate to existing mining and construction activities. In addition, it will require classification and location of problematic coal seams and pyritic shales in three dimensions to permit identification of potential problems due to formation exposure/disturbance

The project will include these elements:

1. Classification of coal seams and pyritic shales based upon geological data and historical evidence of surface and groundwater quality impacts.
2. Literature review and examination of federal and state records to catalog existing mine and construction sites that intersect coal seams and pyritic shales.
3. Compile and review water quality monitoring data from catalogued sites.

4. Geologic mapping of problematic coal seams and pyritic shales using available digital elevation model (DEM) data and boring data.
5. Numerical modeling to predict potential impacts (discrete and cumulative) to water resources of the watershed based upon contaminant loading to surface and groundwater.
6. Identify and document those seams and shales, that if disturbed, have significant potential to cause impacts to water quality of the abed WSR. This information will be used to comment on regulatory permits for proposed mining, development and construction in the watershed.

OBRI-N-21 9.000
Priority: 19

BUDGET AND FTEs

—-—-FUNDED

	Source	Activity	Budget ($1 000's)	FTEs
1999:				
2000:				
2001:				
2002:				
2003:				
		Total:		

•————UNFUNDED

	Source	Activity	Budget (1000's)	FTEs
1999:			21.0	0.1
2000:			36.0	0.1
2001:			66.0	0.1
2002:			21.0	0.1
2003:			6.0	0.1
		Total	150.0	0.5

Compliance codes:
Explanation:
End of data

OBRl-N-220.000
Priority: 20

Title: Inventory Active and Abandoned Mine Lands Impacting abed WSR Water Quality and Assess Extent of Impact
Funding Status: Funded: 0.0 Unfunded: 25.0

Servicewide Issues: Nl0 (MINRLJGEOTHERM) N16 (NEAR-PARK DEV) Nil (WATER QUAL-EXT) N20 (BASELNE DATA)

Cultural Resource Type: C70, C73

RMAP Program Codes: QOI, Ca3, ~aa

Problem Statement

Water resources and riparian environments are principal resources of the abed WSR. The water is considered to be among the highest quality in the State of Tennessee - supporting a rich ecological diversity. However, active and abandoned mines occurring outside the abed WSR Park Service Unit influence the waters within its boundaries. abed WSR waters are subjected to increased acidity and erosion as a result of active and abandoned mine lands from outside its boundaries. However, the specific locations of the mines causing these impacts have not been identified. Until an inventory and assessment of the impacts are completed, mitigation and reclamation cannot begin.

Description of Recommended Proiect or Activity

This project will require a cooperative effort between the NPS, USaSM, and TDEC in the assessment of active and abandoned mine land impacts and the development of mitigation plans in order to rectify this situation. ance the mitigation plans are in place, reclamation can begin.

The project will include these elements:

1. Identify locations of active and abandoned mine lands in the abed watershed.
2. Coordinate with USOSM and TDEC's Mining and Geology sections to identify impacts.
3. Input this data into baseline lands use assessment and mapping project.
4. Prioritize the need for reclamation on active and abandoned mine locations based on likely impact to abed WSR waters.
5. Coordinate with USOSM and TDEC's Mining and Geology sections to recommend reclamation and mitigation procedures.

OBRl-N-22o.000
Priority: 20

BUDGET AND FTEs

——FUNDED —-—

Source	Activity	Budget ($1 000's)	FTEs
1999:			
2000:			
2001:			
2002:			
2003:			
	Total:		

—-————UNFUNDED-

Source	Activity	Budget (1000's)	FTEs
1999:		11.0	0.1
2000:		14.0	0.1
2001:			
2002:			
2003:			
	Total	25.0	0.2

Compliance codes:
Explanation:
End of data

OBRl-N-22o.000
Priority: 20

Title: Inventory Active and Abandoned Mine Lands Impacting abed WSR Water Quality and Assess Extent of Impact
Funding Status: Funded: 0.0 Unfunded: 25.0

Servicewide Issues: Nl0 (MINRL/GEOTHERM)N16 (NEAR-PARK DEV) NI I (WATER QUAL-EXT) N20 (BASELNE DATA)

Cultural Resource Type: C70, C73

RMAP Program Codes: QOl, Ca3, DOO

Problem Statement

Water resources and riparian environments are principal resources of the abed WSR. The water is considered to be among the highest quality in the State of Tennessee - supporting a rich ecological diversity. However, active and abandoned mines occurring outside the abed WSR Park Service Unit influence the waters within its boundaries. abed WSR waters are subjected to increased acidity and erosion as a result of active and abandoned mine lands from outside its boundaries. However, the specific locations of the mines causing these impacts have not been identified. Until an inventory and assessment of the impacts are completed, mitigation and reclamation cannot begin.

Description of Recommended Proiect or Activity

This project will require a cooperative effort between the NPS, USaSM, and TDEC in the assessment of active and abandoned mine land impacts and the development of mitigation plans in order to rectify this situation. ance the mitigation plans are in place, reclamation can begin.

The project will include these elements:

1. Identify locations of active and abandoned mine lands in the abed watershed.
2. Coordinate with USOSM and TDEC's Mining and Geology sections to identify impacts.
3. Input this data into baseline lands use assessment and mapping project.
4. Prioritize the need for reclamation on active and abandoned mine locations based on likely impact to abed WSR waters.
5. Coordinate with USOSM and TDEC's Mining and Geology sections to recommend reclamation and mitigation procedures.

OBRI-N-220.000
Priority: 20

BUDGET AND FTEs

—-———— —FUNDED—-———---———

	Source	Activity	Budget ($1000s) t-Tts
1999:			
2000:			
2001:			
2002:			
2003:			
		Total:	

— UNFUNDED

	Source	Activity	Budget (1000's)	FTE5
1999:			11.0	0.1
2000:			14.0	0.1
2001:				
2002:				
2003:				
		Total	25.0	0.2

Compliance codes:
Explanation:
End of data

OBRI-N-221 .000

Priority: 21

Title: Internet Homepage for Obed WSR
Funding Status: Funded: 0.0 Unfunded: 23.0

Servicewide Issues: 100 (INTERPRETATION OF NATURAL RESOURCE ISSUES)

Cultural Resource Type: N/A

RMAP Program Codes: QO1

Problem Statement

According to NPS's most recent Internet information on national park visitation, recreational visits to the abed WSR far out number those non-recreational visits. In 1993, 226,100 visits to the Obed WSR were oriented toward recreation, whereas only 10,800 were non-recreational. This pattem was also evident when recreational hours (948,900 hours) were compared to non-recreational hours (900 hours), and recreational days (79,100) were compared to non-recreational days (100). Canoeing and kayaking constitute one of the major uses of the Obed WSR. Approximately 5,000 float visits per year occur in the Obed WSR National Park Service Unit annually. Only limited and not easily accessible information on flow gaging and water quality is presently available to recreational users of the abed WSR water resources.

Description of Recommended Proiect or Activity

This project will involve the development of an Internet home page in order to relay abed WSR flow gaging and water quality information to recreational users.

The project will include these elements:

1. Work with NPS communication specialists or outside contracts in the development of an Intemet home page for the Obed WSR. It should be designed to provide current flow data and information exchange.
2. Develop programs and displays designed to disseminate information on water quality information related to the abed WSR.

OBRI-N-221 .000 Pnonty: 21 2003:
Activity Budget ($1 000's) FTEs

BUDGET AND FTEs

FUNDED

Source

1999:

2000:

2001:

2002: Total:

1999:	Activity	Budget (1000's)	FTEs
2000:		21.0	0.1
2001:		1.0	
2002:		1.0	
2003:	Total	23.0	0.1

Compliance codes:

Explanation:

End of data
UNFUNDED.
Source

OBRI-N-222.000
Priority: 22
Title: Determine Trends in the Number of Boatable Days
Funding Status: Funded: 0.0 Unfunded: 64.0

Servicewide Issues: N12 (WATER FLOW)
N20 (BASELINE DATA)
Cultural Resource Type: C70
RMAP Program Codes: QOI, C03

Problem Statement

According to NPS's most recent Internet information on national park visitation, recreational visits to the Obed WSR far out number those non-recreational visits. In 1993, 226100 visits to the Obed WSR were oriented toward recreation, whereas only 10,800 were non-recreational.

The Obed/Emory Watershed offers 142 miles (228.5) kilometers of canoeable whitewater streams, ranging in difficulty from Class I to the highly technical Class V. These streams are some of the best and most difficult whitewater regions in the eastern United States (Smith 1980). And as a result, whitewater paddling is one of the more popular recreational sports in the Obed WSR. In fact, approximately 5,000 float visits to the Obed WSR constituted one of the major park uses in 1996.

Due to this public demand for whitewater recreation, the number of boatable days per year is important in that it supports a highly demanded recreational activity within the Park Unit boundaries. However, no information exists that would indicate what affects proposed public and private watershed impoundments have on hydrology and the number of boatable days in the Obed River.

Boatable days are determined by flow rates which are measured in cubic feet per second (cfs). USGS stream gages on the Obed River near Lancing and on the Emory River at Oakdale have periods of records of 27 years and 69 years respectively. According to NPS and TWRA recreation brochures, boatable days in the Obed WSR National Park Service Unit depend on location, but in general range from a low of 500 cfs to approximately 5,000 cfs with 3,000 cfs being optimum. Development projects within the river basin have a potential to affect the number of boatable days both due to decreased minimum flows or increased high flows

Description of Recommended Project or Activity

The objective of this project is to determine whether or not impoundments have an impact on the number of boatable days. The existing data should be analyzed against rainfall and impoundment data to determine if any trends in the number of boatable days per year exist.

The project will include these elements:

1. Establish criteria for "boatable" days in various portions of the Obed WSR. Particular attention will be given to criteria for gaging stations and trouble spots along the river.
2. Analyze existing stream flow data, against rainfall and impoundment data to determine what factors can be correlated with the number of boatable days.
3. Check annual precipitation to identify long-term hydrologic trends (i.e., stability, increases, and decreases of flows).

OBRI-N-222.000
Priority: 22

4. Using instream flow model, assess effects of currently proposed impoundments and other developments on number of boatable days. Translate into use impacts and economic effects on resource use.
5. Accept natural flows for what they are. Do not create an argument for controlled releases from impoundments.

OBRI-N-222.000
Priority: 22

BUDGET AND FTEs

FUNDED

Source

1999:

2000:

2001:

2002:

2003:

Activity Budget ($1 000's) FTEs

Total:

1999:

2000:

2001:

2002:

2003:

Activity	Budget (1000's)	FTEs
	10.0	0.1
	32.0	0.2
	22.0	0.2
Total	64.0	0.5

Compliance codes:

Explanation:

End of data

------UNFUNDED

Source

Literature Cited

Abbott, T. M. 1979. A water Quality Assessment of Coal Mining Effects on the Obed Wild and Scenic River. Tennessee Technological University, Cookeville, Tennessee.

_____ I 982a. Effects of Coal and Oil Mining Activities and Sewage Effluents on the
Aquatic Fauna: Water Quality Survey of the Obed Wild and Scenic River, Tennessee. U.S. Department of Interior, Atlanta, Georgia.

_____ 1982b. Chemical and Bacteriological evaluation: Water Quality Survey of the Obed Wild and Scenic River, Tennessee. Final Report U.S. Department of Interior National Park Service, Atlanta Georgia. 67 pp.

Ahlstedt, Steve. 1997. U.S. Geological Survey. Personal Communication.

Annis, Clark. 1997. Superintendent, Crossville, Tennessee Wastewater Treatment Facility. Personal Communication.

Arnold, David. 1997. Tennessee Department of Agriculture, Division of Forestry. Personal Communication.

Bakaletz, Steve. 1997. National Park Service, Big South Fork National River and Recreation Area. Personal Communication.

Bible, Robin. 1997. Tennessee Department of Agriculture, Division of Forestry. Personal Communication.

Bowling, David. 1997. Tennessee Valley Authority, Reservoir Operations. Personal Communication.

Braun, E. L. 1950. Deciduous Forest of Easter North America. Hafner Publishing Co., New York. 596 pp.

Cartwnght, Linda. 1997. Tennessee Department of Environment and Conservation, Division of Water Supply. Personal Communication.

Chandler, J. R. 1970. A biological approach to water quality management. Water Pollution Control 4:415 - 422.

Code of Federal Regulations, Title 36, Section 4.10, Travel on Park Roads and Designated Routes.

Collins, Leo. 1997. Tennessee Valley Authority Natural Heritage Program. Personal Communication.

Cowardin, L. M., V. Carter, F. C. Golet, and E.
T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS-79/31. U.S. Fish and Wildlife Service, Washington, D.C.

Crawford, N. C., “Karst Hydrogeology of Tennessee, “Guidebook Prepared for Karst Hydrogeology Workshop, Nashville, Tennessee, August 31 - September 3, 1982.

____ 1987. “The Karst Hydrogeologyofthe Cumberland Plateau Escarpment of Tennessee,” Report of Investigations No. 44, Part 1, Tennessee Department
of Conservation, Division of Geology, Nashville, Tennessee.

____ 1989. “The KarstHydrogeologyofthe Cumberland Plateau Escarpment of Tennessee,” Report of Investigations No. 44, Part 2, Tennessee Department
of Conservation, Division of Geology, Nashville, Tennessee.

Dellapenna. *1991.* The Right to Consume Water Under "Pure" Ripanan Rights. jjj Waters and Water Rights, Robert E. Beck, Editor in Chief, Volume 1: Introduction . Ripananism. The Miche Company, Charlottesville, VA. 768 pp.

Dixon, D. 1996. District Conservationist, Natural Resources Conservation Service, Fentress County, Tennessee. Personal Communication.

Eckenfelder Inc. 1991 a. Report of Toxicity Screening Test Results. Prepared for: Crossville Wastewater Treatment Facility, Crossville, Tennessee.

__1991 b. Report of Toxicity Screening Test Results. Prepared for: Crossville Wastewater Treatment Facility, Crossville, Tennessee.

__1991 c. Report of Toxicity Screening Test Results. Prepared for: Crossville Wastewater Treatment Facility, Crossville, Tennessee.

Gaydos, M. W., and Others. 1982a. "Hydrology of Area 19, Eastern Coal Province, Tennessee," Open-File Report 81-909, U.S. Geological Survey, Nashville, Tennessee.

Goldfarb, W. 1988. Water Law, Second Edition. Lewis Publishers, Inc., Chelsea, Ml, 284 pp.

Herd, Dick. Tennessee Wildlife Resources Agency, Region Ill . Crossville, Tennessee. Personal Communication.

Hollyday, E. F., R. D. Evaldi, and M. W. Bradley. 1985. "Hydrogeologic Data for The Wartburg Area, Morgan County, Tennessee," Unpublished Open File Report 85, United States Geological Survey, Nashville, Tennessee.

Hoos, Anne B. 1990. "Recharge Rates and Aquifer Hydraulic Characteristics for Selected drainage Basins in Middle and East Tennessee," Water-Resources Investigations Report 90-4015, U.S.Geological Survey, Nashville, Tennessee.

Hoyal, M. 1997. Assistant State Geologist, Division of Geology, Tennessee Department of Environment and Conservation. Personal Communication.

Julian, Hank E. 1996. "Groundwater Availability in Cumberland and Fentress Counties, Tennessee," TVA Engineering Laboratory Report.

__1997. Tennessee Valley Authority. Personal Communication.

Karr, J. R. 1981. Assessment of biotic integrity using fish communities. Fisheries 6(6):21-27.

Karr, J. R. and D. R. 1981. Ecological perspective on water quality goals. Environmental Management 5:55 . 68.

Karr, J. R., K. D. Fausch, P. L. Angerrneier, P. R. Yant, and I. J. Schlosser. 1986. Assessing Biological Integrity in Running Waters: A Method and Its Rationale. Ill. Nat. Hist. Surv. Spec. Publ. 5, Urbana.

Leiserson, Alan, 1996. Personal Communications, Tennessee Department of Environment and Conservation, Office of General Council, Nashville, Tennessee.

Mattraw, H. C., Jr., "Letter from Harold C. Mattraw USGS to Dodd Galbreath Tennessee Environmental Policy Office," February 29, 1996.

Mayr, John. 1997. Tennessee Wildlife Resources Agency, Region Ill . Crossville, Tennessee. Personal Communication.

Melgaard, David and David McKinney. 1979. Biological Inventory and Assessment, Obed River, Mile 20.8 to 38.6, Cumberland County. Tennessee Department of Public Health, Division of Water Quality Control, Nashville, Tennessee.

Miller, R. A. 1974. TMThe Geologic History of Tennessee,~ Bulletin 74, Tennessee Division of Geology.

Miller, D. L., P. M. Leonard, R. M. Hughes, J. R. Karr, P. B. Moyle, L. H. Schrader, B. A. Thompson, R. A. Daniels, K. D. Fausch, G. A. Fizhugh, J. R. Gammon, D. B. Halliwell, P. L. Angermeier, and D. J. Orth. 1988. Regional applications of an index of biotic integrity for use in water resource management. Fisheries 1 3(5):12-20.

Mirenda, Richard J. 1991a. Report of Toxicity Screening Test Results (For Crossville Wastewater Treatment Facility). Eckenfelder Inc., Nashville, Tennessee.

_____ 1991 b. Report of Toxicity Screening Test Results (For Crossville Wastewater Treatment Facility). Eckenfelder Inc., Nashville, Tennessee.

_____ 1991 C. Report of Toxicity Screening Test Results (For Crossville Wastewater Treatment Facility). Eckenfelder Inc., Nashville, Tennessee.

National Park Service. 1976. Final Environmental Impact Statement, Proposed Obed National Wild and Scenic River - Tennessee. U.S. Department of The Interior, Bureau of Outdoor Recreation.

_____ 1982a. NPS-2, Planning Process Guideline. U.S. Department of Interior, National Park Service, Washington, D.C.

_____• 1982b. NPS-12, National Environmental Policy Act Guideline. U.S. Department of Interior, National Park Service, Washington, D.C.

_____ 1988. National Park Service Management Polices. U.S. Department of Interior, National Park Service, Washington, D.C.

_____ 1991. NPS-77: Natural resources management guideline. U.S. Department of Interior, National Park Service, Washington, D.C.

_____ 1992. NPS-75, Natural Resources Inventory and Monitoring Guideline. U.S. Department of Interior, National Park Service, Washington, D.C.

—. 1993a. National Park Service Floodplain Management Guidelines. U.S. Department of Interior, National Park Service, Washington, D.C.

_____ 1993b. Resource Management Plan. Southeast Region - Obed Wild and Scenic River. U.S. Department of Interior, National Park Service.

_____ 1995. General Management Plan/Development Concept Plan/Environmental Impact Statement. U.S. Department of the Interior National Park Service.

_____ 1998. NPS Wetlands Protection Procedural Manual 77.1: Final Draft. U.S. Department of Interior, National Park Service, Washington, D.C.

Ohio Environmental Protection Agency. 1988. Biological criteria for the protection of aquatic life. Volumes I - III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Monitoring and Assessment, Columbus, Ohio.

Pelren, David. 1997. U.S. Fish and Wildlife Service - Cookeville, Tennessee Office. Personal Communication.

Pennington and Associates, Inc. 1991. Biological Survey Obed River. Prepared for: City of Crossville, Tennessee.

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates. U.S. Environmental Protection Agency Monitoring and Data Support Division, Washington D.C.

Rikard, Michael. 1985. Obed Wild and Scenic River Water Quality Report. U.S. Department of Interior, National Park Service, Obed Wild and Scenic River, Wartburg, Tennessee.

Rosensteel, B. A. 1996. Review and Analysis of Wetlands in the Obed Wild and Scenic River Park Unit. JAYCOR Environmental, Oak Ridge, Tennessee.

Schmalzer, P. A. 1982. Vegetation of the Obed Wild and Scenic River, Tennessee and a Comparison of Reciprocal Averaging Ordination and Bianry Discriminate Analysis. Ph.D. Dissertation. University of Tennessee, Knoxville.

Schmalzer, P. A. and DeSelm. 1982. "Final Report - Vegetation, Endangered, and Threatened Plants, Critical Plant Habitats and Vascular Flora of the Obed Wild and Scenic River." Prepared for the National Park Service. On file at Big South Fork National River and Recreation Area, Oneida, TN.

Smith, Monte D. 1980. The Obed/Emory River Watershed/A Detailed Guide to 18 Whitewater Canoe Trips. Rocker Associates and Monte Smith.

Smith, Woody. 1997. NPDES Permits. Tennessee Department of Environment and Conservation, Knoxville. Personal Communication.

Spradlin, Etta. 1993. Memorandum: Obed Water Quality Summary. U.S. Department of Interior, National Park Service, Obed Wild and Scenic River, Wartburg, Tennessee.

Stodola, Paul. 1997. Tennessee Department of Environment and Conversation, Water Pollution Control Division. Personal Communication.

Sulkin, Barry W. 1988. Assimilative Capacity Study of the Obed River at Crossville, Tennessee. Tennessee Department of Health and Environment, Division of Water Pollution Control, Nashville,

Swingle, G. 0. 1961. "Structural Geology Along the Eastern Cumberland Escarpment, Tennessee," Report of Investigations No. 13, Division of Geology, Tennessee Department of Conservation and Commerce, Nashville, Tennessee.

Taylor, Cathy A., Ronald S. McKitnck, and Michael R. Pelton. 1981. Terrestrial Vertebrate Inventory of the Obed Wild

Tennessee Department of Environment and Conservation. 1994. The Status of Water Quality in Tennessee 1994 305(b) Report. Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Nashville, Tennessee.

1995. State of Tennessee Water Quality Standards: Rules of the Department of Environment and Conservation, Bureau of Environment, Division of Water Pollution Control, Nashville, Tennessee.

1996. Draft 303(d) List. Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Nashville, Tennessee.

Tennessee Valley Authority. 1958. Floods on the Emory River in Vicinity of Harriman, Tennessee. WA . Division of Water Control Planning. Report Number 0-5816

__1960. Supplemental Flood History for Emory & Obed Rivers and Clear & Daddys Creeks. TVA Division of Water Control Planning. Report Number 0-6082.

__1996. Obed Wild and Scenic River Water Resources Management Plan:
Draft Summary Report of Public Comments. Prepared by: Water Management, Tennessee Valley Authority, Knoxville, Tennessee.

Thompson. 1991. Tennessee. j~Waters and Water Rights, Robert E. Beck, Editor in Chief, Volume 6: State Surveys .Glossary. The Miche Company, Charlottesville, VA. 654 pp.

Treece, Rick. 1996. Water Quality Specialist, U.S. Geological Survey. Personal Communication.

__1997. Water Quality Specialist, U.S. Geological Survey. Personal Communication.

Turner, D. 1996. Environmental Specialist,
Division of Water Pollution Control,
Mining Section, Tennessee Department of Environment and Conservation. Personal Communication.

U.S. Geological Survey. 1996. Flow Durations and Low Flows of Tennessee Streams Through 1992. Water Resource Investigations Report 95-4293.Prepared by USGS, Nashville, Tennessee in cooperation with Tennessee Department of Environment and Conservation and the Tennessee Valley Authority.

Waddle, G. 1996. Physical Scientist, Office of Surface Mining, Knoxville, Tennessee. Personal Communication.

Walker, C.A. 1997. Reclamation Specialist, Office of Surface Mining, Knoxville, Tennessee. Personal Communication.

West, B.J. 1990. The Clean Water Act and
Other Tolls for Managing Water Resources j~ Managing National Park
System Resources, M. Mantell (ed),
The Conservation Foundation, Washington, D.C. pp. 67-84.

Wilson, J. M. 1965. “Groundwater and Geology of Cumberland County, Tennessee,” Tennessee Department of Conservation, Division of Water Resources.

Wojtowicz, John and Byron F. Clark. 1989.
An Intensive Survey of the Obed River, Cumberland County, Tennessee 1988. Tennessee Department of Health and Environment, Division of Water Pollution Control, Nashville, Tennessee.

Appendices

Appendix A:

Federal Laws, Regulations and Executive Orders Pertinent to Management of NPS Water Resources and Watersheds Affecting the Obed WSR Park

National Park Service Organic Act of 1916

Through this **act** Congress established the NPS and mandated that it "shall promote and regulate the use of the federal areas known as national parks, monuments, and reservations.., by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." This act was reinforced by Congress in 1970 with legislation stating that all park lands are united by a common preservation purpose, regardless of title or designation. Hence, all water resources in the national park system are protected equally by federal law, and it is the fundamental duty of the NPS to protect those resources unless otherwise indicated by Congress.

Wild and Scenic Rivers Act of 1968

In accordance with this act, it is "the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. The purpose of this act is to implement this policy by instituting a national wild and scenic rivers system, by designating the initial components of that system and by prescribing the methods by which and standards according to which additional components may be added to the system from
time to time." Section 2 of this act states that:
"The national wild and scenic rivers system shall comprise rivers (i) that are authorized for inclusion therein by act of Congress, or (ii) that are designated as wild, scenic or recreational rivers by or pursuant to an act of the legislature of the state or states through which they flow, that are to be permanently administered as wild, scenic or recreational rivers by an agency or political subdivision of the state or states concerned, that are found by the Secretary of the Interior upon application of the Governor of the state or the Governors of the states concerned, or a person or persons thereunto duly appointed by him or them, to meet the criteria established in this act and such criteria supplementary thereto as he may prescribe, and that are approved by him for inclusion in the system, including, upon application of the Governor of the state concerned."

In 1976, Public Law 94-486 amended the original act to establish the Obed Wild and Scenic River (Obed WSR) encompassing 45.2 river miles on portions of the Obed and Emory Rivers, and Clear and Daddys Creeks in Morgan and Cumberland Counties, Tennessee. The NPS has primary management responsibilities for the Obed WSR. Lands currently within Obed WSR boundaries that are part of the Catoosa Wildlife Management Area (Catoosa WMA) will continue to be owned and managed by the State of Tennessee, TWRA in such a way as:

> "to protect the wildlife resources and the primitive character of the area and without further development of roads, campsites or associated recreational facilities unless deemed necessary by that agency for wildlife management purposes."

The legislation required that a development plan be prepared and include a cooperative

agreement between the two agencies due to their joint management responsibilities.

Although the Obed is only one unit in the national wild and scenic rivers system—a system containing some 158 rivers nationally (as of I 996)—it is one of only nine such units that have been authorized in the Southeastern U.S.. It is the only National Wild and Scenic River in the State of Tennessee and the only Wild and Scenic River managed by the Southeast Region of the NPS.

National Park Service
General Authorities Act of 1970

The General Authorities Act of 1970 amended the NPS Organic Act of 1916. It defined the national park system as including all the areas administered by the NPS "...for park, monument, historic, parkway, recreational, or other purposes," and declared that all units in the System will be managed in accordance with their respective individual statutory directives, in addition to the Congressional direction found in the Organic Act and other relevant legislation, providing the general legislation does not conflict with specific provisions.

Redwood National Park Act

In 1978, in an act expanding Redwood National Park (i.e., Redwood National Park Act), NPS general authorities were further amended to specifically mandate that all park system units be managed and protected "in light of the high public value and integrity of the national park system" and that no activities should be undertaken "in derogation of the values and purposes for which these various areas have been established," except where specifically authorized by law. Thus, by amending the General Authorities Act of 1970, the act reasserted System-wide the high standard of protection prescribed by Congress in the original Organic Act.

The Redwood Act qualifies the provision that park protection and management "shall not be exercised in derogation of the values and purposes for which these various areas have been established, "by adding" except as may have been or shall be directly and specifically provided for by Congress." Thus, specific provisions in a park's enabling legislation allow park managers to permit activities such as hunting and grazing. While the qualification can clearly be interpreted narrowly (i.e., in those situations and within those parks where Congress explicitly authorizes an activity that threatens park resources), because the direction is to the Secretary, it arguably could be interpreted more broadly to include, for example, the multiple-use management on adjacent federal lands that can affect park resources.

Federal Water Pollution Control Act (Clean Water Act) of 1972

The Federal Water Pollution Control Act, more commonly known as the Clean Water Act, was first promulgated in 1972 and amended in 1977, 1987, and 1990. This law is designed to restore and maintain the integrity of the nation's water, including the waters of the national park system. Goals set by the act were swimmable and fishable waters by 1983 and no further discharge of pollutants into the nation's waterways by 1985. The two strategies for achieving these goals were a major grant program to assist in the construction of municipal sewage treatment facilities, and program of "effluent limitations" designed to limit the amount of pollutants that could be discharged. Effluent limitations are the basis for permits issued for all point source discharges, known as the National Pollutant Discharge Elimination System (NPDES). The Environmental Protection Agency (EPA) has set limits for pollutants that may be released based on available technology and cost of treatment for various industrial categories.

As part of the act, Congress recognized the primary role of the states in managing and regulating the nation's water quality within the general framework developed by Congress. Part of that framework, namely Section 313, requires that all federal agencies, including the NPS, comply with the requirements of state law for water quality management, regardless of other jurisdictional status or land-ownership. States implement the protection of water quality under the authority granted by the Clean Water Act through BMPs and through water quality standards. Standards are based on the designated uses made of a water body or segment, the water quality criteria

necessary to protect that use or uses, and an anti-degradation provision to protect the existing water quality. Criteria are descriptions of maximum or minimum physical, chemical, and/or biological characteristics of water that reflect tolerances and requirements for human health, aquatic biota, and aesthetics which will protect the designated uses. Designated uses for the waters of Tennessee (including the Obed WSR) include: sources of water supply for domestic and industrial purposes, propagation and maintenance of fish and other aquatic life; recreation in and on the water including the safe consumption of fish and shell fish; livestock watering and irrigation; navigation; generation of power; propagation and maintenance of wildlife; and the enjoyment of scenic and aesthetic qualities of waters. The standards also serve as the basis for water quality-based treatment and establish the water quality goals for the specific stream segment or water body. A triennial review of a state's water quality regulatory program is conducted by a state's water quality agency to determine if the standards are adequate. These standards are then forwarded to the EPA for approval.

The EPA promotes the concept that a state's anti-degradation policy (adopted as part of the States' Water Quality Standards) which represents a three-tiered approach to maintaining and protecting various levels of water quality and uses. At its base, the existing uses of a water segment and the quality level necessary to protect the designated uses are maintained (i.e., water quality can be degraded as long as the designated uses are protected). This establishes the absolute foundation for water quality. The second level provides protection of existing water quality in segments where quality exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water (i.e., those segments meeting the "fishable/swimmable" goals of the Clean Water Act). In such segments, only limited water quality degradation can be allowed after it has been shown through a demonstration process, which includes public participation, that the quality will continue to support the "fishable/swimmable" uses. The third tier provides special protection for waters for which ordinary use classification may not suffice and which are classified as "Outstanding National Resource Water"—a designation used by the State of Tennessee. The purpose of this special designation is to safeguard a state's highest quality waters and also to maintain the quality of waters that have ecological importance.

Section 401 of the Clean Water Act requires that any applicant for a federal license or permit to conduct an activity which will result in a discharge into waters of the U.S., shall provide the federal agency from which a permit is sought a certificate from the state water pollution control agency that any such discharge will comply with applicable water quality standards. Federal permits which require Water Quality Certification from the Tennessee Division of Water Pollution Control include 404 permits from the USACE for the discharge of dredged or filled material, 26(a) permits from the WA to insure that no adverse effects to WA reservoirs will result from a proposed action, and permits for hydroelectric projects from the Federal Energy Regulatory Commission (see full discussion in planning section).

Section 402 of the act requires that a National Pollutant Discharge Elimination System (NPDES) permit be obtained for the discharge of pollutants from any point source into the waters of the United States. Point source, waters of the United States, and pollutants are all broadly defined under the act. However, generally all discharges and storm water runoff from municipalities, major industrial and transportation activities, and certain construction activities must be permitted by the NPDES program. The State of Tennessee has been delegated NPDES permitting authority by the EPA. The State, through the permitting process, establishes the effluent limitations and monitoring requirements for the types and quantities of pollutants that may be discharged into its waters. Under the anti-degradation policy, the State must also insure that the approval of any NPDES permit will not eliminate or otherwise impair or degrade any designated uses of the receiving waters.

Section 404 of the Clean Water Act further requires that a permit be issued for discharge of dredged or fill materials in waters of the United States including wetlands. The USACE administers the Section 404 permit program

with oversight and veto powers held by the EPA.

Rivers and Harbors Appropriation Act of 1899

This act established the USACE regulatory authority over United States navigable waters. The act established permit requirements for construction of bridges, causeways, dams, or dikes within or over navigable waters of the United States. Bridges and causeway construction is regulated by the Transportation Secretary, while dam and dike permits are reviewed by the USACE. Section 10 of the act requires a Corps permit for construction of any "obstruction of navigable waters" of the U.S., and for any excavation, fill, or other modification to various types of navigable waters. Section 13 requires a Corps permit for discharge of refuse of any kind (except liquid from sewers or urban runoff) from land or vessel, into the navigable waters of the United States or into their tributaries. Similarly, discharge of refuse is prohibited upon the banks of navigable waters or their tributaries where the refuse could be washed into the water.

Endangered Species Act of 1973

The Endangered Species Act requires the NPS to identify and promote the conservation of all federally listed endangered, threatened or candidate species within park or preserve boundaries. While not required by legislation, according to NPS ManaQement Policies (NPS 1988), it is NPS's policy to also identify state and locally listed species of concern, and support the preservation and restoration of those species and their habitats. As of 1996, the USFWS lists five threatened and endangered species and one critical habitat within the boundaries of the Obed WSR.

This act requires all entities using federal funding to consult with the Secretary of the Interior on activities that potentially impact endangered flora and fauna. It requires agencies to protect endangered and threatened species as well as designated critical habitats.

Fish and Wildlife Coordination Act of 1965

This act requires federal agencies to consult with the USFWS, or National Marine Fisheries Service, and with parallel state agencies, whenever water resource development plans result in alteration of a body of water. The Secretary of the Interior is authorized to assist and cooperate with federal agencies to "provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs."

Energy Policy Act (EPA) of 1992

One major provision of EPA (1992) was a broadening of the existing ban on development of hydroelectric projects within national parks. New language bans new hydroelectric development within any unit of the national park system, including recreational areas, historical sites, and other units of the NPS. Previously, the ban affected only national parks and not other NPS units.

Safe Drinking Water Act of 1986

This act directs EPA to publish and enforce regulations on maximum allowable contaminant levels in drinking water. The act requires EPA to issue regulations establishing national primary drinking water standards; primary enforcement responsibilities lie with the states. The act also protects underground sources of drinking water; primary enforcement responsibilities again lie with the states. Federal agencies having jurisdiction over public water systems must comply with all requirements to the same extent as any non-governmental entity.

Sales of Park Water Under Public Law 91 - 383 (August 18, 1970)

Request for the NPS to provide water from park springs to a community adjacent to Grand Canyon National Park resulted in the Passing of Public Law 91 -383 in 1970 and its amendment in 1976 (P.L. 94-458). This law provides for the NPS to enter into contracts to sell or lease water to nearby communities, while recognizing that water is necessary for

the protection of scenic, natural, cultural and scientific resources. The law establishes several tests that must be met before park waters can be sold or leased. Among the tests are: (1) that no reasonable alternative source of water exists, (2) that the services supported by the water sale are for the direct or indirect benefit of the park or park visitors, (3) that it is demonstrated that the sale is not detrimental to the park, its resources and visitors, (4) that the sale is consistent with federal water rights, and (5) that any agreement is short term and revocable at any time. Any agreement to sell or lease water must also be reviewed by the appropriate congressional committees.

Floodplain Management Executive Order (No. 11988)

The objective of Executive Order (EO) 11988 (Floodplain Management) is "... to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative" (VVRC 43 FR 6030). For non-repetitive actions, EO 11988 states that all proposed facilities must be located outside the limits of the 100-year floodplain unless alternatives are evaluated which would either identify a better option or support and document a determination of "no practicable alternative" to siting within the floodplain. If this determination can be made, adverse floodplain impacts would be minimized during design of the project. West (1990) suggested that park service managers should ensure that where park resources fall within flood hazard areas, these areas are properly marked to increase public awareness of potential flood dangers at the site. To the extent possible, park facilities such as campgrounds and rest areas should be located outside these areas. NPS guidance pertaining to Executive Order 11988 can be found in Floodplain Management Guidelines (NPS 1993a). It is NPS policy to recognize and manage for the preservation of floodplain values, to minimize potentially hazardous conditions associated with flooding, and to adhere to all Federally Mandated laws and regulations related to the management of activities in flood-prone areas. Specially, it is the policy of the NPS to:

- Restore and preserve natural floodplain values;
- Avoid to the extent possible, the long and short-term environmental impacts associated with the occupancy and modification of floodplain, and avoid direct and indirect support of floodplain development wherever there is a practical alternative;
- Minimize risk to life and property by design or modification of actions in floodplain, utilizing non-structural methods when possible, where it is not otherwise practical to place structures and human activities outside of the floodplain; and
- Require structures and facilities which must be in floodplain to be designed so as to be consistent with the intent of the Standards and Criteria of the National Flood Insurance Program (44 CFR 60).

Protection of Wetlands Executive Order (No. 11990)

Executive Order 11990, entitled "Protection of Wetlands", requires all federal agencies to "minimize the destruction, loss or degradation of wetlands, and preserve and enhance the natural and beneficial values of wetlands" (Goldfarb 1988). Unless no practical alternatives exists, federal agencies must avoid activities in wetlands which have the potential for adversely affecting the integrity of the ecosystem. NPS guidance for compliance with Executive Order 11990 can be found in Floodplain Management and Wetland Protection Guidelines, published in the *Federal Register* (45 FR 35916, Section 9). The Wetland Regulatory Compliance: A Guidance Manual for the National Park Service Mid-Atlantic Region (NPS 1989) should also be consulted for issues pertaining to wetlands.

Pollution Control Standards Executive Order (No. 12088)

Executive **Order** 12088, entitled "Federal Compliance with Pollution Control Standards", requires adequate sewage treatment and disposal be provided for all public use and administrative facilities within the national park system

Section 26(a) of the TVA Act

The unified development and regulation of the Tennessee River system requires that no dam, appurtenant works, or other obstruction, affecting navigation, flood control, or public lands or reservations shall be constructed, and thereafter operated or maintained across, along, or in the said river or any of its tributaries until plans for such construction, operation, and maintenance shall have been submitted to and approved by the board; and the construction, operation, or maintenance of such structures without such approval is hereby prohibited. When such plans shall have been approved, deviation therefore either before or after completion of such structures is prohibited unless the modification of such plans has previously been submitted to and approved by the board.

Federal Power Act (FPA) of 1920 and Electric Consumers Protection Act (ECPA) of 1986

The Federal Energy Regulatory Commission (FERC), under the FPA, is authorized to issue licenses for the construction, operation, and maintenance of dams, water conduits, reservoirs, power houses, transmission lines, and other physical structures of hydro-power projects. If such structures will affect the navigable capacity of any navigable waters of the U.S., the plans must be approved by the Chief of Engineers and the Secretary of the Army. ECPA significantly strengthened the role of fish and wildlife agencies and reinforced the "equal consideration" standard for evaluating non-power values in hydroelectric development.

Resource Conservation and Recovery Act (RCRA)

This act governs the generation, transportation, treatment, storage, and disposal of current and future actively produced hazardous waste, solid waste, and underground storage tanks. Federal agencies are subject to federal, state, and local requirements. The act authorizes a comprehensive program that regulates hazardous waste from generation to ultimate disposal ("cradle to grave"). Subtitle D of RCRA (Solid Waste) is regulated through state programs. Regulations for hazardous waste management are in the Federal Register starting at 40 CFR 260. They are immediately preceded by certain solid waste regulations.

Food Security Act of 1985

Commonly known as the "Swam pbuster Act," this legislation restricts a number of federal benefits to farmers who, after December 23, 1985, produce agricultural commodities on certain "converted wetlands." Knowledge of the provisions of this law is useful for management of agricultural special use permits and in protecting park resources from impacts associated with agriculture on inholdings and adjacent lands.

Water Resources Planning Act and Water Resource Council's Principles and Standards Act of 1965

This act states a national policy exists "to encourage the conservation, development, and utilization of water and related land resources on a comprehensive and coordinated basis by the federal government, states, localities, and private enterprises..." Water Resources Council (WRC) principles and standards for planning water and related land resource uses are revised to achieve national economic development and environmental quality objectives.

Federal Water Project Recreation Act of 1965

In this act, congress established the policy that in the construction of water resource projects, full consideration is to be given to recreation and fish and wildlife enhancement. The act authorizes the federal government to pay up to one half of the costs of projects which have non-federal public involvement, if the nonfederal entity(-ies) agree(s) to administer the project land and water areas for fish and wildlife and recreation enhancement, or both.

Watershed Protection and Flood Prevention Act of 1968

This act authorizes the Secretary of the Interior to cooperate with state and local governments, including soil and water conservation districts and flood control districts, in planning and analyzing trends in flood protection and watershed conservation activities and facilities. The Secretary is to be consulted about such proposed "works of improvement," with regard to activities or facilities that may affect Department of the Interior (DOI) lands.

Antiquities Act of 1906

This act authorizes the President to declare national monuments to protect sites and objects; authorizes federal departments to grant permits for survey and excavation and for gathering of "objects of antiquity" and to enforce protection of archeological sites and objects under their junsdiction; and requires that materials excavated be permanently preserved in public museums.

Archaeological Resources Protection Act of 1979

This was enacted to prevent the illegal excavations and possession of archaeological resources located on federal, other public, and Indian lands. In passing this act the Congress recognized that the only comparable statutory law, the 1906 Antiquities Act, was inadequate in terms of defining archeological resources and establishing appropriate penalty provisions. The act called for regulations to be promulgated jointly by the Secretaries of Interior, Agriculture, Defense, and the Chairman of the Board of the TVA.

Preservation of Historic and Archaeological Data Act of 1974

This act amended the Reservoir Salvage Act of 1960, and provides for preservation of significant scientific, prehistoric, historic, or archaeological data (including relics and specimens) that might be lost or destroyed as a result of: 1) the construction of dams, reservoirs, and attendant facilities, or 2) any alteration of the terrain caused as a result of any federal construction project or federally licensed project, activity, or program.

Surface Mining Control and Reclamation Act (SMCRA) of 1977

The purpose of this act is to establish a nationwide program to protect the environment from adverse effects of surface coal mining operations, to establish minimum national standards for regulating surface coal mining, to assist states in developing and implementing regulatory programs, and to promote reclamation of previously mined areas left without adequate reclamation. The act contains several provisions that are important to park protection at Obed WSR. While no active coal mines exist in Obed WSR, two active coal mines operate near the park. Also, to date, two abandoned coal mines have been identified in the park and have undergone some degree of safety hazard mitigation. Finally, an abandoned mine exists in proximity to the park's boundary.

Under §522(e), the Act prohibits surface coal mining in units of the National Park System subject to "valid existing rights." This same section also prohibits surface coal mining that will adversely affect any publicly owned park or place on the National Register of Historic Places unless the mining proponent has" valid existing rights" to mine or if the agency with jurisdiction over the park or place gives its approval. Because of Obed WSR's location within a known coal area, both of these provisions provide an added level of protection to the park's resources and visitor values. In Tennessee, because the state does not have a state approved regulatory program, the implementation of the above provisions and the actual permitting of surface coal mines in the state rests with the USOSM.

Via §401 of the Act, Congress established the Abandoned Mine Reclamation Fund which receives funds from currently mined coal on a per ton basis. The Fund serves as a source of moneys for reclaiming land and water adversely affected by coal mining. To be eligible for funding, the lands and water had to have been mined or adversely affected by coal mining prior to enactment of the Act. Funds may be expended on both public and private land.

36 CFR Non-federal Gas Rights

Pursuant to the Mining in Parks Act of 1978, the NPS developed regulations found at 36 CFR Part 96, to provide protection of park resources that could be affected by the exercises of these re9ulations apply to all activities within any unit of the national park system in the exercise of rights to oil and gas not owned by the U.S., where access is on, across, or through federally owned or controlled lands or waters" (Section 9.30). The regulation sections specific to water include regulated use of water; required description of natural resources, including water, impacted by operations; and measures to protect surface and subsurface water. All operation plans must be reviewed and approved by (in the case of the Obed WSR) the Director of the Southeast Field Area.

Clean Air Act of 1990

The main purpose of the Clean Air Act is to protect and enhance the nation's air quality to promote the public health and welfare. The act establishes specific programs that provide special protection for air resources and air quality related values associated with NPS units. The Obed WSR is designated as a Class II Clean Air area under the Clean Air Act, as amended (42 USC 7401 et seq.). Section 118 of the Clean Air Act requires all federal facilities to comply with state laws. The Tennessee Department of Environment and Conservation (TDEC), Office of Pollution Control, is responsible for ensuring that all activities within the Obed WSR comply with existing federal, state, and local air pollution control laws and regulations.

Federal Compliance with Pollution Introduction of Exotic Species Executive Order (No. 11987)

The objective of Executive Order (E.O.) 11987 is to "...restrict the introduction of exotic species into the natural ecosystems on lands and waters which they (federal agencies) own, lease, or hold for purposes of administration; and, shall encourage the states, local governments and private citizens to prevent the introduction of exotic species into natural ecosystems of the U.S.."

Control Standards Executive Order (No. 12088)

E.O. 12088 requires that federal agencies, including the NPS, cooperate with state, intrastate, and local agencies in the prevention, control, and abatement of environmental pollution.

Off-road Vehicle Use Executive Orders (No.'s 11644 and 11989)

When the enabling legislation allows the use of off-road vehicles, the NPS is required to manage off-road vehicle use under a policy that park unit lands will be closed to such use except for areas or trails specifically designated as open. If it is determined that such use is adverse to resources, the NPS is to immediately close such areas or trails until the effects have been corrected.

Farmland Protection Policy (45 F 59189)

Federal agencies are required to analyze the impacts of federal actions on prime and unique agricultural lands.

APPENDIX B:

List of Rare, Threatened and Endangered Species

Scientific Name	Common Name	Federal Status	State Status	Probable Habitat
Plants				
Adlumia fungosa	Climbing fumatory		THR	Sandstone boulder fields
Amelanchier sanguinea	Foundleaf shadbush		THR	Gravel/sand bars
Arenaria cumberlandensis	Cumberland sandwort	LE		
Aureolaria patula	False foxglove		THR	
Calamovilfa arcuata	Cumberland sand grass		END	Gravel/sand bars
Conradina verticillata	Cumberland rosemary	LT	THR	Gravel/sand bars
Eupatorium luciae-brauniae	Lucy Braun's white snakeroot		THR	
Helenium brevifolium	Shortleaf sneezeweed		END	Gravel/sand bars
Helianthus eggertii	Eggert's sunflower		SPCO	Gravel/sand bars
Hexastylis contracta	Southern heartleaf		THR	Mixed oak & hemlock forests
Hydrastis canadensis	Goldenseal		THR	Mesic deciduous forests
Leucothoe racemosa	Fetter-bush		THR	Gravel/sand bars
Marshallia grandiflora	Large-flowered Barbara's buttons		END	Gravel/sand bars
Panax quinquefolius	American ginseng		THR	Mesic deciduous forests
Polygonella americana	Southern jointweed		END	Gravel/sand bars
Polymnia laevigata	Tennessee leafcup		SPCO	Sandstone boulder fields
Schwalbea americana	American chaffseed	LE	E-P	
Silphium brachiatum	Cumberland rosinweed		END	
Spiraea virginiana	Virginia spiraea	LT	END	
Sporobolus junceus	a drop seed		SPCO	Gravel/sand bars
Talinum teretifolium	Roundleaf fameflower		THR	Sandstone outcroppings
Trillium pusillum var. ozarkanum	Ozark least trillium		END	
Utricularia subulata	Zizzag bladderwort		THR	
Invertebrates				
Villosa perpurpurea	Purple bean pearly mussel	LE	END	Riffle areas of Obed River
Lampsilis virescens	Alabama pearly mussel	LE	END	Riffle areas of Emory River
Vertebrates				
Corynorhinus rafinesquii	Eastern big-eared bat		NMGT	Cliff faces, caves, hollow trees
Cryptobranchus alleganiensis	Hellbender		NMGT	
Cyprinella monacha	Spotfin chub	LT	END	Obed & Emory Rivers, Clear & Daddys Creeks

Scientific Name	Common Name	Federal Status	State Status	Probable Habitat
Desmognathus welteri	Black Mountain salamander		NMGT	small streams
Esox masquinongy ohioensis	Muskellunge			
Etheostoma cinereum	Ashy darter		NMGT	
Hemidactylium scutatum	Four-toed salamander		NMGT	Mossy areas in bogs, small ponds
Lutra canadensis	River otter		THR	rivers, streams
Neotoma magister	Allegheny woodrat		NMGT	karst plains, caves, cliff faces
Ophisaurus attenuatus	Eastern slender glass lizard		NMGT	old fields, woodlots
Percina aurantiaca	Tangerine darter		NMGT	rocky pools of creeks and small rivers
Percina macrocephala	Longhead darter		THR	rocky, flowing pools of creeks and small rivers
Picoides borealis	Red-cockaded woodpecker	LE	END	
Sorex fumeus	Smokey shrew		NMGT	damp forested areas

Federal Status Designations:

LE: Listed endangered.
LT: Listed threatened.
PE: Proposed endangered

State Status Designations:

END: State endangered
THR: State threatened
E-P: Endangered - possibly extirpated
SPCO: Special concern
NMGT: In need of management

Appendix C:

State of Tennessee Laws, Programs, and Regulations Pertinent to Management of NPS Water Resources and Watersheds Affecting the Obed WSR

Water Rights in Tennessee

The riparian water rights doctrine governs the use of surface water in Tennessee. Riparian rights are related to, and arise from, ownership of land abutting a body of water. The NPS is considered a riparian landowner since it owns land abutting the streams comprising Obed WSR. The rights of those who own the land include consumptive and non-consumptive uses (Dellapenna 1991).

Although it is not specifically stated, the State of Tennessee is considered to adhere to the theory of reasonable use for purposes of allocating both surface and groundwater. Reasonable use is defined as "each owner of riparian land is permitted to use the water in a waterbody, regardless of the effect the use has on the natural flow, so long as each user does not transgress the equal right of other ripanans to use the water" (Dellapenna 1991). Reasonableness under the riparian doctrine is not subject to simple definition and is decided by the courts after examining many factors such as purpose of use, suitability to watercourse, economic or social value, harm caused by the use, practicality of avoiding harm by adjusting use of one or both of the parties, and the protection of existing values. Typically, riparian rights are asserted for water diverted out of the stream. Ripanan rights could be asserted downstream from existing diversions to maintain flow levels (assuming flow levels could be reasonably maintained, given hydrologic conditions of the stream) for beneficial and reasonable uses of water.

Under the Riparian Doctrine, no formal priority exists for water uses. However, Tennessee appears to recognize two preferred uses of water: withdrawal of water for domestic use, and instream use for navigation (Thompson 1991). It is unclear if domestic use includes municipal uses. It appears the courts have recognized at least five instream uses of water: navigation, recreation, hydroelectric power generation, fish and wildlife preservation, and aesthetic enhancement (Thompson 1991). Though not a water right requirement per Se, a permit must be obtained from the Tennessee Division of Water Resources for all water uses (except public water systems) greater than 50,000 gallons per day.

A list of Tennessee laws, programs, and regulations considered by the NPS to be the most pertinent to the Obed WSR's water resources follows. For a more thorough list, see Appendix C.

Water Quality Control Act of 1971

The Water Quality Control Act of the State of Tennessee aims to protect water quality through regulation of pollution sources, monitoring of streams and lakes and public education. The State Water Quality Control Board is identified, in the act, as having the duty to investigate all problems associated with the pollution of Waters of the State. The Board has the authority to grant permission or abate any activities that may result in pollution of the Waters of the State. It has the authority to establish such standards of quality for any Waters of the State in relation to their reasonable and necessary use as the Board deems to be in the public interest. The Board can also establish general policies relating to pollution, as it deems necessary to accomplish the purposes of the act.

State Protected Water **Uses.** The State of Tennessee Water Quality Standards, part of the Water Quality Control Act, describe the reasonable and necessary uses of water within the State that are deemed to be in the public interest. Such uses include: sources of water supply for domestic and industrial purposes, propagation and maintenance of fish and other aquatic life; recreation in and on the waters including the safe consumption of fish and shell fish; livestock watering and irrigation;

navigation; generation of power; propagation and maintenance of wildlife; and the enjoyment of scenic and aesthetic qualities of waters, and all apply to the Obed and Emory Rivers. State Protected Water Uses designated for the abed/Emory River watershed are found in Table 1.

Some of the criteria described within State Protected Water Uses include, but are not limited to dissolved oxygen, pH, hardness or mineral compounds, total dissolved solids, solids, floating materials and deposits, turbidity or color, temperature, coliform, taste or odor, toxic substances, and one criteria that deals with other pollutants. State Water Quality Standards insure that the Waters of the State shall not contain other pollutants in quantities that may be detrimental to public health or impair the usefulness of the water as a source of domestic water supply.

State Water Quality Standards also define what is considered to be unacceptable discharges into Waters of the State. To quote this section of the Standards, "Sewage, industrial wastes, or other wastes, as defined in the Water Quality Control Act. Sec. 69-3-101, *et. seq.,* shall not be discharged into or adjacent to streams or other surface waters in such quantity and of such character or under such conditions of discharge in relation to the receiving waters as will result in visual or olfactory nuisances, undue interference to other reasonable and necessary uses of the water or appreciable damage to the natural processes of self-purification. In relation to the various qualities and the specific uses of the receiving water, no sewage, industrial wastes, or other wastes discharged shall be responsible for conditions that fail to meet the water quality standards. Bypassing is prohibited except where necessary to prevent loss of life or severe property damage, or where excessive storm drainage or runoff would damage treatment facilities."

As outlined in the Water Quality Control Act: "All discharges of municipal sewage, industrial waste, or other wastes shall receive the greatest degree of effluent reduction which the Commissioner of the Tennessee Department of Environment and Conservation determines to be achievable through application of stringent effluent limitations and schedules of compliance either promulgated by the Water Quality Control Board, required to implement any applicable water quality standards, including where practicable, a standard permitting no discharge of pollutants, necessary to comply with a State Water Quality Plan, or necessary to comply with other state or federal laws or regulations."

State Anti-degradation Policy. An anti-degradation policy, which applies to the Obed WSR, is found within the State Water Quality Standards. The Tennessee Anti-degradation Statement is as follows: "It is the purpose of Tennessee's standards to fully protect existing uses of all surface waters as established under the act.... The Tennessee Water Quality Standards shall not be construed as permitting the permanent degradation of high quality surface waters. Characteristics of high quality waters include: (a) Waters designated by the Water Quality Control Board as ONRWs in accordance with Section 1200-4-3-.06 (3), (b) Waters that provide habitat for ecologically significant populations of aquatic or semiaquatic plants or animals, including those identified on State of Tennessee or USFWS lists of rare, threatened, or endangered species, (C) Waters that provide specialized recreational opportunities related to existing water quality, (d) Waters that possess outstanding scenic or geologic values, (e) Water where existing conditions are better than water quality standards."

Waters of the State receiving the ONRWs designation by the Water Quality Control Board are considered to be high quality waters which constitute an outstanding national resource, such as waters of national and state parks and wildlife refuges and waters of exceptional recreational or ecological significance. Existing water quality will be the criteria in these waters. Existing discharges, including existing upstream discharges will be allowed at present levels. No new discharges, expansions of existing discharges, or mixing zones will be permitted in waters with this designation unless such activity can consistently meet or exceed the water quality conditions of the ONRW or unless such activity will not result in permanent degradation of the water quality. Physical alterations that cause permanent degradation to the ONRW will not be allowed."

No permanent degradation is allowed by the State of Tennessee unless and until it is affirmatively demonstrated to the Water Quality Control Board, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that a change is justifiable as a result of necessary economic or social development and will not interfere with or become injurious to any classified uses, deemed to be in the public interest, existing in such waters (see State Protected Water Uses section for a listing of uses). Existing discharges, including existing upstream discharges, will be allowed at present levels. Regulated non-point sources will be controlled to the extent possible under the Water Quality Control Act and standards. Non-point sources exempted from permit requirements under the Water Quality Control Act should utilize all cost-effective and reasonable BMP5.

TDEC's Division of Water Pollution Control issues several types of permits. Activities requiring permits include the discharge of a pollutant to public waters, the alteration of aquatic resource, and gravel dredging from a watercourse. The Division also issues permits for mineral mining and reviews or certifies permits issued and administered by federal agencies. Additionally, construction or modification of wastewater treatment facilities must be carried out in accordance with plans approved by the Division.

NPDES Permitting System. There are three sections within the Water Pollution Control Division which have National Pollutant Discharge Elimination System (NPDES) responsibilities. The Mining Section issues NPDES Permits for all mining in Tennessee. Surface Mining as well as NPDES Permits are issued under T.C.A. 59-8-204 for the "other minerals" or non-coal operations subject to regulation under this act. The USOSM issues Mining Permits for coal. The Municipal Facilities Sections issue municipal, small domestic, and industrial permits. Wasteland allocations are computer simulations of discharges into a receiving stream. The model calculates the levels of pollutants in the stream and estimates decay rates. Permit limits are adjusted according to the results of the model. A Total Maximum Daily Load (TMDL) also uses computer models to estimate pollutant loading into a stream. However, a TMDL estimates loading from both point and non-point sources of pollution. Because they are very labor and time intensive, TMDLS are typically only performed on streams that have water quality problems that waste-load allocations and new permit limits have not solved.

Pretreatment Program. The federal pretreatment regulations require all state agencies administering the NPDES permit Program to develop and administer a state pretreatment program. The pretreatment program is designed to reduce the loading of pollutants into municipal facilities as a way to improve compliance rates. The program is also responsible for sludge disposal, protecting the receiving stream, and enforcing pretreatment standards.

The Division is requiring a significant number of wastewater plants to develop a pretreatment program as the primary vehicle for administering, applying, and enforcing National Pretreatment Standards (40 CFR Part 403.S and 403.6) for industrial users. This strategy requires wastewater plants to have complete local programs whereby notification of industrial users concerning pretreatment standards will be the responsibility of the municipality. The Division will then have an oversight role in which a minimal amount of resources will be committed to applying and enforcing National Pretreatment Standards against indirect discharges.

Section 404 Certification. Section 404 of the federal Clean Water Act regulates the disposal (discharge) of dredged or fill material into the waters of the Untied States, including wetlands. The USACE and the USEPA administers this program. The USACE has primary responsibility for the permit program.

Section 401 of the Clean Water Act requires that before a 404 Permit may be issued, the state must first certify that the proposed activity will not violate local water quality regulations and standards. The Division's Natural Resources Section reviews USACE 404 Permit applications for compliance with the state's regulations and issues certificates as prescribed by Section 401 of the Clean Water Act. Without state certification or waiver of certification, the 404 Permit cannot be granted. The Nashville District of the

USACE reviews permits in the Obed River watershed.

The TDEC's Division of Water Pollution Control issues Aquatic Resource Alteration Permits and General Permits for Alteration of Aquatic Resources, both permits pertaining to water quality, under the authority of the Tennessee Water Quality Control Act of 1977 (T.C.A. 69-3-101). This act authorizes water quality permits primarily for work resulting in modification of the physical or biological properties of the waters of the State (TDEC 1994).

Aquatic Resource Alteration Permit (ARAP). Aquatic Resource Alteration permits are required for any alteration of waters of the State including wetlands if a Federal 404 permit, under the Clean Water Act, is not required. Examples of stream alteration activities requiring permits include:

- dredging, widening, straightening, bank stabilization
- levee construction
- channel relocation
- water diversions or dams
- water withdrawals
- flooding, excavating, or draining a wetland

General Permits for Alteration of Aquatic Resources. General permits are available for certain activities that involve alterations of waters of the State. General permits provide authorization for activities that cause minimal individual or cumulative impacts to water quality. The regulations establish specific, enforceable standards of pollution control for work authorized by them. General permits are available for the following activities:

- construction of launching ramps,
- alteration of wet weather conveyances,
- minor road stream crossings
- utility line stream crossings
- bank stabilization (of streams)
- sand and gravel dredging, within the stream corridor
- debris removal

Safe Drinking Water Act of 1983

Recognizing that the waters of the State are the property of the State and are held in public trust for the benefit of its citizens, the act declares that the people of the State are beneficiaries of this trust and have a right to both an adequate quantity and quality of drinking water.

The Water Environmental Health Act of 1984

Recognizing that correct operation of water and wastewater systems is necessary for the protection of the public health and the quality of the environment, the Act's declared purpose is to prevent inadequate operation of all such systems through a system of certification of operators and penalties for non-compliance.

The Safe Dams Act of 1973

The Safe Dams Act provides that on or after July 1, 1973, no person shall construct, enlarge, repair, alter, remove, maintain, or operate a non-federal dam in the State of Tennessee without first obtaining a certificate. The act further requires every owner of a dam file with the Commissioner of Health and Environment an application for a certificate.

Under the act, certain provisions and conditions are established for the issuance and continuance of certificates, and authority is granted the Commissioner for the adoption of general rules and regulations he deems necessary to accomplish the purpose of the act. To safeguard the public by reducing the risk of failure of such dams, the certain rules and regulations are made to: 1) effect the orderly inventory and inspection of existing dams in Tennessee; 2) provide for pre-construction review and approval of all future dam construction and alteration of dams; and 3) allow for a program of regular inspection of dams within the State.

Mineral Test Hole Regulatory Act of 1982

This act regulates the drilling of mineral test holes in order to prevent the pollution of potable water resources, both surface and

subsurface, as the result of the introduction of undesirable substances, including natural bnnes, oil, gas, or mineralized waters through the process of the drilling of mineral test holes; and provide basic geologic data to the State relating to oil, gas and water occurrences.

Oil and Gas Surface Owners Compensation Act of 1984

The general assembly of the State of Tennessee finds that the exploration for and development of oil and gas reserves must coexist with the equal right to the use, agricultural or otherwise, of the surface of land within the State. Therefore, it is the purpose of this act is to provide constitutionally permissible protection and compensation to surface owners of land on which oil and gas wells are drilled for the burden resulting from such drilling operations.

Applicable Rules of the Tennessee State Oil and Gas Board

The Oil and Gas Board of the State of Tennessee was created in order to conserve the natural resources of the State and to prevent waste oil and gas. In the State, the Oil and Gas Board has jurisdiction and authority over oil and gas exploration and exploitation. This authority extends to the ability to establish rules, regulations (pursuant to power delegated by Title 60, Tennessee Code Annotated, entitled Oil and Gas and Other Acts of the Legislature of the State of Tennessee), and orders and to investigate and inspect equipment, records, properties, and leases.

Rule number 1040-2-6-04 of the Rules of the Tennessee State Oil and Gas Board deals with environmental protection as well and supports Section 60-1-701 of the State codes. It states that: “All oil and gas operations shall be conducted in manner that will prevent or mitigate adverse environmental impacts such as soil erosion and water pollution. All areas disturbed by the operations, including access roads, shall be reclaimed as prescribed in rule 1040-2-9-05. Access roads shall be constructed in such a manner as to reduce erosion to a practical minimum. Sediment ponds, berms, diversion ditches, hay bales, and other measures designed to prevent erosion and discharge from well sites shall be taken to prevent or minimize soil erosion and pollution or surface waters.”

Rule number 1040-2-7-04 of the Board Rules deals with the isolation of oil, gas and fresh-water bearing strata, and potential minable coal and other mineral deposits. It states that:
“... all potential minable coal and other minerals must be isolated from any possible communication through the annulus with oil, gas or water-bearing strata or deposits of other potential minable coal or other minable minerals....”

Tennessee Mineral Surface Mining Law of 1992

The general assembly of the State of Tennessee finds that: unregulated surface mining of minerals can cause soil erosion and landslides, stream pollution, and accumulation and seepage of contaminated water; contributes to floods; impairs the value of land for agricultural or other purposes; affects fish and wildlife and their habitats; counteracts efforts for the conservation of soil, water and other natural resources; impairs the owners’ rights in neighboring property; creates fire hazards; and in general creates conditions inimical to life, property and the public welfare. Therefore, it is the purpose of the Tennessee Mineral Surface Mining Law of 1972 to provide the necessary regulation and control of surface mining so as to minimize its injurious effects.

Abandoned Mine Lands Reclamation Program

This regulation governs the procedures for reclaiming lands and waters affected by past mining practices using the Federal Abandoned Mine Reclamation Fund. Objectives of this plan are as follows:

1. The primary objective of the Program is the protection of public health, safety, general welfare and property from the adverse effects of past mining practices.
2. Socio-economic Objectives include:

- the utilization, whenever possible, of the services of local contractors for reclamation work.
- the improvement of the local forest and agricultural economy by putting abandoned mine land back into production.
- the preservation of historical, cultural, and archaeological resources that have been affected or threatened by past mining practices by applying reclamation treatment that is compatible with these resources.

3. Recreation Objectives include:
   - the restoration of recreational areas adversely affected by past mining to as near their undisturbed condition as possible.
   - the coordination of reclamation activities and project areas with those of other state and federal agencies concerned with recreational areas affected by abandoned mine lands.
4. Flora and Fauna Objectives include:
   - the restoration or enhancement of the adversely affected habitats of plants and animals to a condition equal to or greater than their pre mining condition, with particular attention to the habitats of endangered or threatened species of plants and animals.
   - the coordination of abandoned mine land reclamation activities with the TWRA.
   - the avoidance to the fullest extent practicable of any significant adverse impacts to fish or wildlife species or their habitats as a result of reclamation activities.

Regulations for Public Water Systems and Drinking Water Quality

The purpose of these Rules and Regulations is to provide guidelines for the interpretation of Section 68-221-701 et *seq.* of the Tennessee Code Annotated and to set out the procedures to be followed by the Department in carrying out the State's primary enforcement responsibility under the Federal Safe Drinking Water Act. These Rules and Regulations are promulgated by the board in accordance with the State's Safe Drinking Water Act which specify contaminants which may have an adverse effect on the health of persons and specify a maximum contaminant level for each such contaminant and monitoring, reporting and record-keeping requirements as determined by the board. These Rules and Regulations also set out the requirements which agents, employees or representatives of public water systems must meet in the following areas: in the preparation and submission of plan documents for public water systems; in the supervision of all phases of construction; in supplying safe drinking water meeting all applicable maximum contaminant levels or treatment technique requirements; in providing adequate operation and maintenance of the system; and in complying with procedural requirements for appealing orders issued by the Commissioner of the TDEC against a public water system.

Underground Injection Control

The purpose of these regulations is to protect groundwater resources of the State. The authority of this rule is included in that authority given the Board to protect waters of the State pursuant to T.C.A. Sec. 69-3-1 03 (29), "Water means any and all water, public or private, on or beneath the surface of the ground, which are contained within, flow through, or border up on Tennessee or any portion thereof except those bodies of water confined to and retained within the limits of private property in single ownership which do not combine or effect a junction with natural surface or underground waters. Regulations have also been established by the State to Govern Subsurface Sewage Disposal Systems and Solid Waste Management Systems to protect groundwater resources.

Appendix D:

Obed WSR Wetlands Inventory

Location	NWI Wetland Class	Jurisdictional	Approx. Size (acres)
Obed River Mile			
0 - 1	None		
1 - 2	R3RS2C	No	2 - 3
3 - 4	None		
4 - Clear Cr. confl.	PSS1A	Possible yes	0.5 - 1
	PSS1A	Possible yes	1.5 - 2
Clear Cr. confl. - 8	None		
8 - ≈19	None		
18.5 - Sugar Camp Branch	None		
Sugar Camp Branch to Adams Bridge	PFO1A	Possible yes	5 - 7
Clear Creek Mile			
0 - 4	None		
5.5 - 6.5	None		
8 - 13.5	None		
5 - 8	None		
13.5 - ≈15	None		
15 - Bice Creek	None		
Daddys Creek Mile			
0 - Boundary	None		

R3RB2H: Riverine Upper Perennial Rock, Rubble, Permanently Flooded
R3RS2C: Riverine Upper Perennial Rocky Shore, Rubble, Seasonally Flooded
PSS1A: Palustrine Scrub - Scrub Broad-Leaved Deciduous, Temporarily Flooded
PFO1A: Palustrine Forested Broad-Leaved Deciduous, Temporarily Flooded

Appendix E:

Fish Species Collected by TVA's Watts Bar, Fort Loudoun & Melton Hill River Action Team in 1996

Scientific Name	Common Name
Ambloplites rupestris	Rock bass
Ameiurus natalis	Yellow bullhead
Campostoma anomalum	Central stoneroller
Cyprinella galactura	Whitetail shiner
Cyprinella monacha	Spotfin chub
*Cyprinus carpio	Common carp
Etheostoma blennioides	Greenside darter
Etheostoma rufilineatum	Redline darter
Etheostoma vulneratum	Wounded darter
Hypentelium nigricans	Northern hog sucker
*Lepomis auritus	Redbreast sunfish
Lepomis gulosus	Warmouth
Lepomis megalotis	Longear sunfish
Luxilus chrysocephalus	Striped shiner
Luxilus coccogenis	Warpaint shiner
Lythrurus ardens	Rosefin shiner
*Micropterus coosae	Redeye bass
Micropterus dolomieu	Smallmouth bass
Micropterus punctulatus	Spotted bass
Micropterus salmoides	Largemouth bass
Moxostoma duquesnei	Black redhorse
Moxostoma erythrurum	Golden redhorse
Nocomis micropogon	River chub
Notropis leuciodus	Tennessee shiner
Notropis stramineus	Sand shiner
Notropis telescopus	Telescope shiner
Notropis volucellus	Mimic shiner
*Oncorhynchus mykiss	Rainbow trout
*Perca flavescens	Yellow perch
Percina aurantiaca	Tangerine darter
Percina caprodes	Logperch
Percina squamata	Olive darter
Pylodictis olivaris	Flathead catfish

*Indicates fish species not considered native to the Obed River Watershed.

Appendix F:

Results of Benthic EPT Sampling

Clear Creek

Location	EPT Date
Norris Ford	7/23/96
Stream Mile: 14.8	EPT Score: 13

Species	Taxa Count	Abundance
Turbellaria		
Tricladida		
Planariidae	1	R
Crustacea		
Decapoda	1	R
Insecta		
Plecoptera		
Perlidae	1	C
Perlodidae	1	C
Odonata		
Calopterygidae	1	R
Macromiidae	1	C
Ephemeroptera		
Baetidae	1	R
Ephemerellidae	1	R
Ephemeridae	1	R
Heptageniidae	2	C
Oligoneuriidae	1	R
Heteroptera		
Corixidae	1	C
Nepidae	1	R
Trichoptera		
Helicopsychidae	1	R
Hydropsychidae	2	R
Leptoceridae	3	C
Limnephilidae	2	C
Philopotamidae	1	
Polycentropodidae	1	
Megaloptera		
Corydalidae	1	C
Sialidae	1	R
Diptera		

Location	EPT Date
Waltham Ford	4/30/96
Stream Mile: 8.7	EPT Score: 19

Species	Taxa Count	Abundance
Oligachaeta	1	R
Crustacea		
Decapoda	1	R
Insecta		
Plecoptera		
Leuctridae	1	R
Nemouridae	1	R
Perlidae	1	C
Perlodidae	2	C
Odonata		
Aeshnidae	1	R
Coenagrionidae	1	R
Gomphidae	2	R
Libellulidae	1	R
Macromiidae	1	R
Ephemeroptera		
Baetidae	3	C
Ephemerellidae	5	A
Heptageniidae	3	C
Leptophlebiidae	1	R
Oliganeuriidae	1	R
Siphlonuridae	1	R
Trichoptera		
Brachycentridae	2	C
Glossosomatidae	1	R
Hydropsychidae	2	R
Hydroptilidae	2	C
Leptoceridae	1	R
Limnophilidae	2	R
Philopotamidae	1	R
Polycentropodidae	2	R
Rhyacophilidae	1	R

Daddys Creek

Location	EPT Date
Devil's Breakfast Table	7/24/96
Stream Mile: 2.3	EPT Score: 17

Species	Taxa Count	Abundance
Turbellaria		
Tricladia		
Planariidae	1	C
Oligachaeta	1	R
Crustacea		
Isopoda	1	C
Amphipoda	1	A
Decapoda	1	R
Oligachaeta	1	R
Insecta		
Plecoptera		
Chloroperlidae	1	R
Perlidae	1	R
Perlodidae	1	C
Odonata		
Aeshnidae	2	C
Calopterygidae	1	R
Gomphidae	3	C
Macromiidae	1	R
Ephemeroptera		
Baetidae	2	C
Caenidae	1	R
Ephemerellidae	1	R
Ephemeridae	1	R
Heptageniidae	3	C
Leptophlebiidae	1	R
Siphlonuridae	1	C
Heteroptera		
Veliidae	1	C
Trichoptera		
Hydropsychidae	2	C
Leptoceridae	3	R
Limnophilidae	2	R
Crustacea	1	C
Isopoda	1	A
Amphipoda	1	R
Decapoda		

Obed River

Location	EPT Date
Potters Ford	5/9/96
Stream Mile: 20.8	EPT Score: 19

Species	Taxa Count	Abundance
Turbellaria		
Tricladida		
Planariidae	1	R
Oligochaeta	1	R
Crustacea		
Isopoda	1	R
Decapoda	1	R
Oligochaeta	1	R
Insecta		
Plecoptera		
Chloroperlidae	1	R
Leuctridae	1	R
Nemouridae	1	C
Perlidae	1	R
Perlodidae	1	R
Odonata		
Aeshnidae	1	R
Gomphidae	1	R
Macromiidae	1	R
Ephemeroptera		
Baetidae	3	C
Baetiscidae	1	R
Ephemerillidae	5	A
Heptageniidae	3	C
Leptophlebiidae	1	R
Oligoneuriidae	1	C
Siphlonuridae	1	R
Trichoptera		
Brachycentridae	1	R
Hydropsychidae	1	R
Hydroptilidae	1	R
Lepidostomatidae	1	R
Leptoceridae	1	R
Crustacea	1	R
Isopoda	1	R
Decapoda		

Appendix G:
Contact List in Preparation of this Document

Crossville, Tennessee Wastewater Treatment Facility
Clark Annis, Superintendent
(615) 484-6257

Natural Resources Conservation Service

Cumberland County, TN:
Wilma Tabor
(423) 484-5442

Fentress County. TN:
Dwight Dixson
(615) 879-8212

Tennessee Technological University

Dr. Hunter, retired Professor of Botany
(615) 372-3134

Tennessee Department of Environment and
Conservation
2700 Middlebrook Pike, Suite 220
Knoxville, TN 37921

Division of Water Pollution Control:
Jonathan Burr
(423) 594-6035
Paul Stodola
(423) 594-5584

Morgan County. TN:
(423) 346-3849

Upper Cumberland Development District
Henry Bowman
(615) 432-4111

Rural Economic and Community Development
Dwight Stamps
(615) 528-6539

Fentress County Executive
Stoney Duncan
(615) 879-7713

Tennessee Department of Economic and Community Development
James Mills, Cumberland County Planner
(615) 528-8331
David Starnes, Fentress and Jamestown
Planner
(615) 528-8331

Tennessee State Planning Office

Upper Cumberland Regional Office:
George James
(615) 528-1577

Middle Tennessee State University (MTSU)
Dr. Thomas Hem merly, Professor of Botany
(615) 898-2847

Division of Abandoned Land Reclamation:
(423) 594-6203

Division of Groundwater Protection:
(423) 594-6035

Division of Solid Waste Management:
(423) 594-6035

Division of Surface Mining:
Tim Eagle
(423) 594-6035
Dave Turner
(423) 594-6035

Division of UnderQround Storage Tanks:
Glen Banks
(423) 594-5457

Division of Water Supply:
(423) 594-6035

NPDES Permits:
Woody Smith
(423) 594-5521

Tennessee Department of Environment and
Conservation
401 Church Street, L&C Annex, 6th Floor
Nashville, TN 37243-1 534

Oil and Gas Program:
Mike Hoyal
(615) 532-1504

Division of Water Pollution Control:
Greg Denton
(615) 532-0699
Barbara S. Hamilton
(615) 532-0998

Division of Archaeology:
Don Merritt
(615) 741-1588

Division of Ecological Services:
Reggy Reeves
(615) 532-0431

Division of Water Supply:
Linda Cartwright
(615) 532-0191 or 0192
Robert Foster
(615) 532-0191 or 0192

Watershed Division:
Carol Freeman
(615) 532-0696
Sherry Wang
(615) 532-0656

State Aquatic Resource Alteration Permits (ARAP):
Robby Baker
(615) 532-0710

Division of Underground Storage Tanks:
(615) 532-0945

Division of Geology:
Ron Zurawski, State Geologist
(615) 532-1504
Mike Hoyal, Assistant State Geologist
(615) 532-1504

Tennessee Department of Agriculture

Division of Forestry:
David Arnold, Marketing Forester
(615) 360-0732
Robin Bible, Water Quality
(615) 360-0737
Tennessee Wildlife Resources Agency, Region III

Divsion of Forestry:
Carl Kilmer, District Forester
(615) 484-3084
John Gregory, Forester
(615) 781-6612
Ed Smith, Forester Rockwood, TN
(423) 354-0258

Real Estate/Forestry:
Brant Miller, Chief Forester
(615) 781-6550

Wildlife Management:
Dick Herd
(615) 484-9571

National Park Service

Obed Wild and Scenic River Park Unit:
Don Forester, Superintendent, Obed WSR
(423) 346-6295
Monika Mayr, Former Superintendent, Obed WSR
(305) 230-1144, ext. 3004

Big South Fork National River Recreation Area:
Ron Cornelius, NPS GIS Coordinator
(423) 569-9778

National Park Service, Fort Collins, CO

Water Resources Division:
Dan McGlothlin
(970) 225-3536

National Park Service, Denver, CO

Water Resources Division:
Mark Flora
(303) 969-2956

National Park Service, Great Smoky Mountains National Park Headquarters, Gatlinburg, TN

Fisheries Division:
Steve Moore, Fisheries Biologist
(423) 436-1250

Park Ranger Division:
Bob Whiteman, Head
(423) 436 1261

Maintenance Division:
Sue McGill, Head
(423) 436-1235

Management Division:
Wayne Williams, Head of Resources
(423) 436-1520

National Park Service, Arlington, VA

Water Resources Division:
Frank Panek
(703) 358-1856

National Park Service, Southeast Region
100 Alabama Street SW
Atlanta Federal Center
1924 Building,
Atlanta, GA 30303

Lands Division:
Wally Brittain
(404) 562-3175
John Fisher
(404) 562-3124
Suzette Kimball
(404) 562-3100
Karol Neville
(404) 331-5897

Natural Resources Division:
David Spencer, NPS Technical Assistant, Natural Resource Management Team
(404) 562-3113

National Parks and Conservation Association
Don Barger, Southeast Regional Director
(423) 494-7008

United States Fish and Wildlife Service
Cookeville, Tennessee
Brad Bingham (615) 528-6481 David Pelren (615) 528-6481

United State Geological Survey
Knoxville, Tennessee
Steve Alhstedt, Aquatic Biologist
(423) 545-4140
Jeff Powell, Hydrologic Technician
(423) 545-4140
Rick Treece, Water Quality Specialist

(423) 545-4140

United States Department of Agriculture

Rural Development Office:
Keith Head, Water 2000 Study (615) 783-1345
Department of the Interior, Office of Surface Mining, Reclamation and Enforcement

Knoxville Field Office:
Gerald Waddle, Physical Scientist
(423) 545-4103

Tennessee Valley Authority

Water Manaaement Division:
Dan Fisher, TVA Permits
(423) 632-1559
John Jenkinson, Threatened and Endangered Species Specialist
(423) 751-6903
George Peck, Aquatic Biologist
(423) 632-1787
Charlie Saylor, Aquatic Biologist
(423) 632-1779

Recreation:
George Humphrey
(423) 632-1606
Abraham H. Loudermilk, Jr.
(423) 632-6656

Corporate Library:
Ed Best
(423) 632-7859

Law Library:
Debra Cherry
(423) 632-6613

Office of General Council/Legal Services:
Clay Davis
(423) 632-7774
Teresa C. Scarlett
(423) 632-6605
Archaeologoical Resources:
Bennett Graham
(423) 632-1583

Danny Olinger (423) 632-1569

Heritage Program:
Leo Collins, Terrestrial Flora,
(423) 632-1594
Hill Henry, Terrestrial Zoology,
(423) 632-1570
Peggy Shute, Aquatic Fauna,
(423) 632-1661

Reservoir Operations:
David Bowling
(423) 632-6964
Cris Hughes
(423) 632-6196

Wetlands:
Wes K. James
(423) 988-2433

Water Withdrawals and Effluents:
Phil Mummert
(423) 632-8975

Groundwater Resources:
Jack Milligan
(423) 751-7360